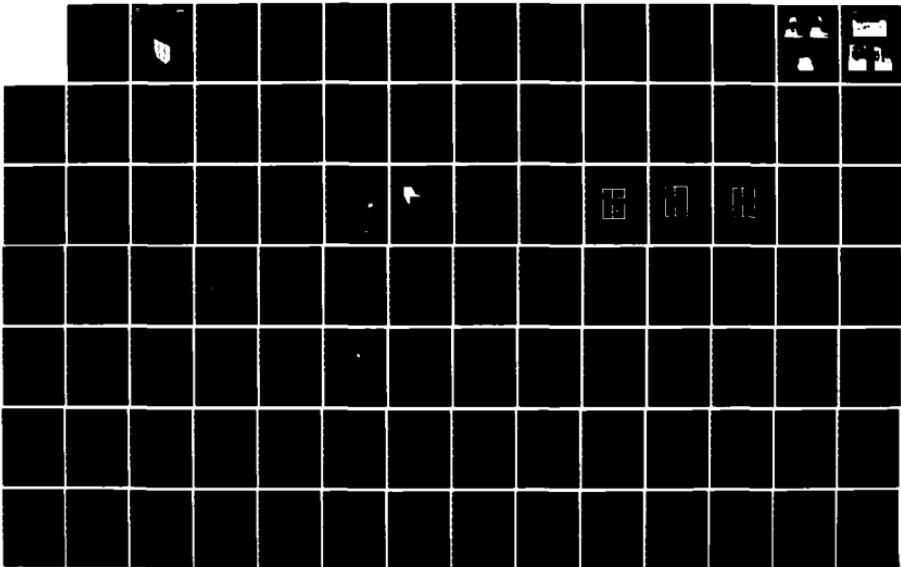
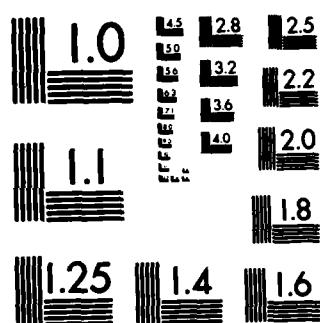


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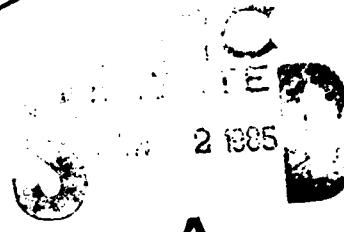
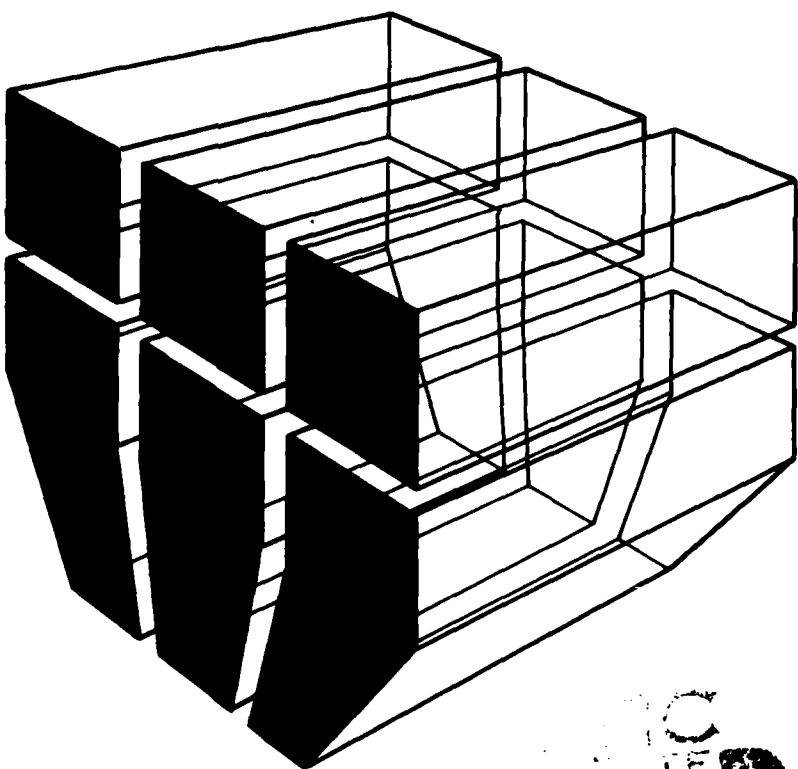
TECHNICAL REPORT P-85/02
October 1984

AD-A148 840

PROTOTYPE CONCEPT DESIGN FOR U.S. ARMY TYPE IIIA
AIR TRAFFIC CONTROL TOWER (ATCT)

by
T. R. Napier
M. E. Lierman

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In April 1983, the U.S. Army Air Traffic Control Activity requested the U.S. Army Construction Engineering Research Laboratory to develop a prototype concept design for a Type IIIa Air Traffic Control Tower (ATCT). The design was to be for a prefabricated, modular, and transportable building system that could be fabricated, placed in storage, deployed, and erected in a variety of configurations.		

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BLOCK 20. (Continued)

This report documents the development of functional requirements for the Type IIIa ATCT, as well as considerations for its prefabrication, transportation, and erection. The report also presents the prototype concept design for the Type IIIa ATCT. The design includes architectural drawings as well as descriptions of the building system's construction approach and materials. Information needed to acquire these facilities is presented, including recommendations for a One-Step or Two-Step procurement approach and guidance to Corps personnel for executing this approach. Finally, the report provides an outline for bid documentation, including an outline specification for the building system.

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FOREWORD

This research was conducted for the U.S. Army Communications Command Air Traffic Control Activity (ATCA) under Project Order CCQ-83-31, dated 21 April 1983.

The work was conducted by the Facility Systems (FS) Division of the U.S. Army Construction Engineering Research Laboratory (USA-CERL). The USA-CERL Principal Investigator was Mr. Thomas R. Napier. Contributions to this study were made by Mr. Richard Schneider and Mr. Robert Porter, both of USA-CERL-FS. Mr. Bruce Donaldson, CCQ-DD, was the ATCA Technical Monitor. Structural engineering and analysis support was provided by Professor David Wickersheimer, of Wickersheimer Engineers, and the School of Architecture, University of Illinois.

Mr. E. A. Lotz is the Chief of USA-CERL-FS. COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.

A1



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PROTOTYPE CONCEPT FOR U.S. ARMY TYPE IIIa AIR TRAFFIC CONTROL TOWER (ATCT)

1 INTRODUCTION

Background

The U.S. Army Air Traffic Control Activity (ATCA) oversees air traffic control and controller training operations at U.S. Army installations worldwide. A recent assessment of Army air traffic control requirements has revealed the need for a standard Air Traffic Control Tower (ATCT) design suitable for installation at new sites or for replacing existing ATCT structures to upgrade ATC capabilities. The ATCA has built three Type III ATCTs. Their construction was based on a U.S. Navy design for a prefabricated, modular, transportable ATCT building system. Although serviceable, the towers have many problems with regard to their design and functional adequacy, habitability, operations, and maintenance. ATCA therefore requested that the U.S. Army Construction Engineering Research Laboratory (USA-CERL) develop an improved design for this type of tower that could be used as a standard in the future.

ATCA required that the design, called Type IIIa ATCT, be prefabricated, of modular configuration, transportable, storable, and capable of being deployed and erected at any location worldwide. These requirements introduced complexities beyond the architectural design and building technology used in the original facilities and required the use of industrialized building concepts and facility acquisition procedures amenable to the upgraded requirements.

Purpose

The purpose of this report is to (1) document the functional requirements and design analysis on which the Type IIIa ATCT is based, (2) display the Prototype Concept Design used for this ATCT, and (3) outline the methodology and documentation for designing, fabricating, deploying, and erecting these facilities.

Approach

Functional operations were observed at other ATCT installations, with U.S. Army air traffic controllers and ATCA personnel providing input on functional requirements. Construction of a Type III ATCT was observed, with input on constructibility characteristics received from the erection contractor, ATCA, and Installation Corps of Engineers personnel.

Construction criteria were then developed for anticipated deployment locations and for other locations representing worldwide structural and environmental conditions. Various considerations regarding storage, transportation, and prefabricated building were also investigated. Based on these

criteria and considerations, the Prototype Concept Design and the construction approach were then developed. The facility acquisition approach and outline documentation were developed on the basis of USA-CERL work with prefabricated and modular building systems, facilities acquisition procedures, and performance specifying.

Users of This Report

ATCA, the initial recipient of this report, will find documented the functional and design requirements of the Type IIIa ATCT and the Prototype Concept Design. They should then arrange with an Army engineering agency--probably a Corps of Engineers District--to complete the construction documentation and administer the procurement.

This report is also directed to the Corps District that will complete the Type IIIa ATCT procurement by documenting ATCA's functional and design requirements and displaying the Prototype Concept Design. This report presents an acquisition methodology for the District to pursue, identifies unique considerations for the project's procurement, fabrication, and construction, and outlines the content and format of the procurement documents. The information in this report may be used as a guide for administering acquisition of the Type IIIa ATCT.

Mode of Technology Transfer

It is recommended that the Prototype Concept Design, procurement methodology, and procurement document guidance in this report be incorporated into the District's procurement and bidding documents for Type IIIa ATCT acquisition.

2 EXISTING TOWER DESIGN

Description

The existing Type III ATCT design is a 40-ft* tower (30-ft cab floor elevation) constructed of four vertically stacked, prefabricated 12-ft by 16-ft by 10-ft steel-frame modules. The cab module houses air traffic control functions, while the tower structure below the cab houses recording equipment, restroom, break, and administrative activities. The cab has a "usable" net area of less than 50 sq ft; each of the lower three modules has about 85 sq ft of "usable" net area. Figure 1 shows the existing cab plan. The tower modules are constructed in a volumetric, box-type configuration. The primary structural members are structural steel channels welded into box sections, while joists and studs are cold-rolled members. Both the interior and exterior walls are plywood panels with prefinished aluminum faces, attached in board-and-batten fashion. Insulation is fiberglass batt.

Three Type III ATCTs have been fabricated and deployed for Army use. They are located at Troy Airport (Fort Rucker, AL), Redstone Arsenal, AL, and MacKall Airfield (Fort Bragg, NC). Each has been built on a site-constructed masonry base, with the cab floor elevated to 40 ft (50-ft overall height). Figures 2 and 3 show the Troy Airport tower.

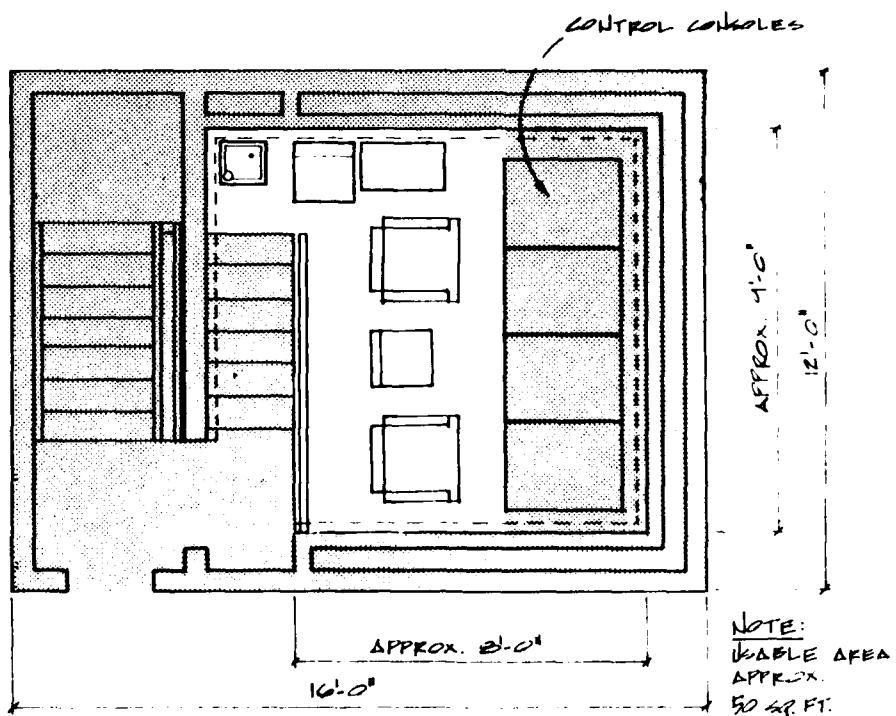


Figure 1. Existing tower design--cab plan.

*Metric conversion factors are provided on p 114.

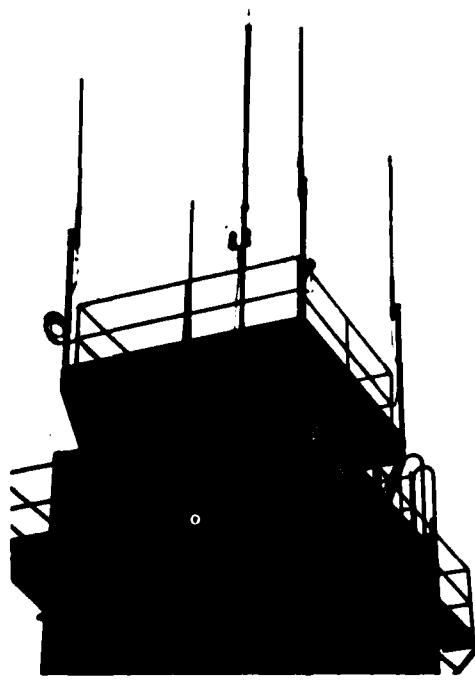
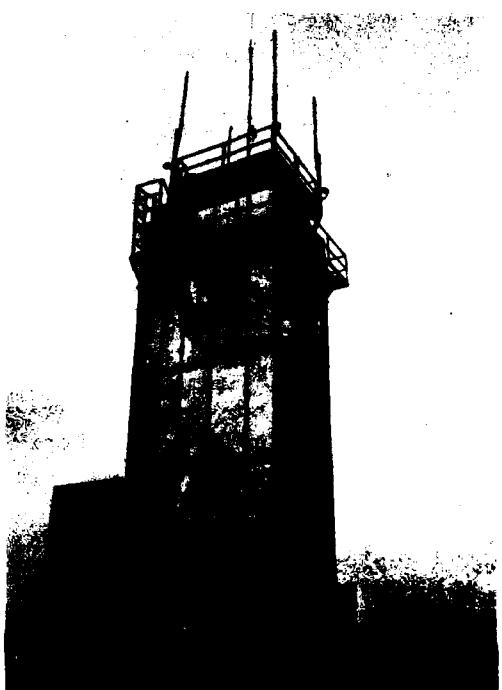


Figure 2. Troy Airport tower (exterior).

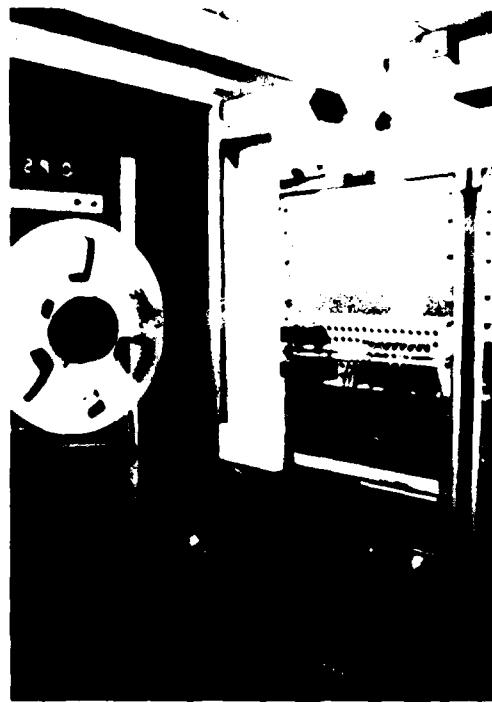
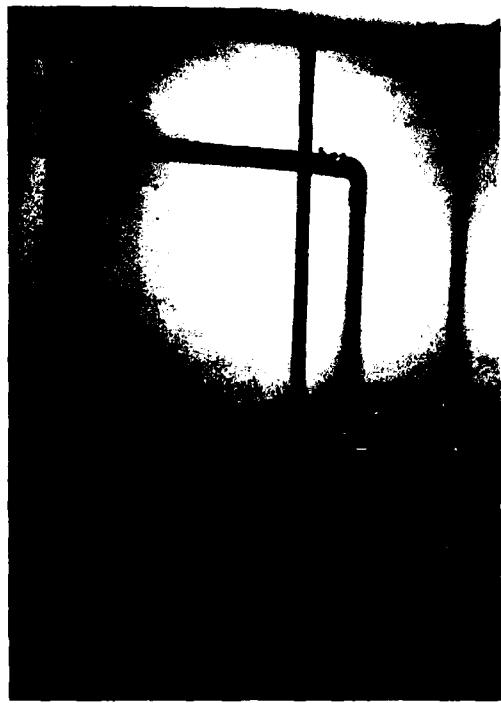


Figure 3. Troy Airport tower (interior).

Problem Areas

Although an exhaustive evaluation of design and construction problems was not undertaken, several general problem areas have become apparent during erection and use of the tower. These problems, listed below, have been addressed in the Prototype Concept Design.

1. Tower height: An additional story was required in all three installations. The resulting masonry base unit was extensive and expensive. It was suggested that the new design use an additional stair module to provide a taller tower.

2. Space and area: All areas of the tower are crowded. This problem is especially critical in the cab and equipment/support module immediately below the cab.

3. Design and function: Examples of poor functional arrangements within the tower include the cab's visual obstructions, remoteness of restroom facilities from the cab, inconvenient access to the catwalk, and intrusion of the mechanical chase and HVAC units into working spaces.

4. Environmental design: Environmental control in the cabin is inadequate. Design adequacy to accommodate environmental conditions in other locations is unknown due to the fragmented construction documentation. Direct exposure of structural members to both exterior and interior environments (thermal bridging) causes overheating in summer and overcooling and condensation in winter. Floors are always cold in winter. These problems are especially critical in the cab where controller comfort is important. The adequacy of the refrigeration unit to pump refrigerant to the full tower height and the logic of its design are also questionable.

5. Weatherability: The vertical batten closures between panels interfere with horizontal closure, so the seal at the module juncture can leak. Other leaks occur at entrance doors, wall openings, and cab window gaskets. The cab roof is poorly drained, having a single drainage point and improper slope, which causes ponding and leakage. Improper sealants at window frames has caused corrosion.

6. Erection: Parts lists and instructions had been lost or misplaced and were not available for guidance when the tower was erected. The development of instructions from incomplete information provided erroneous weight indications for the modules, thus hindering cab placement. Module-to-module tie plates did not align and had insufficient tolerance for variation in module placement. As a result, holes for final bolting had to be redrilled.

7. Workmanship: In several instances, construction workmanship was of poor quality. There were missing bolts, poor welds, loosened floor and ceiling tiles, missing baseboards, and inoperative hardware and equipment. "Blisters" were noted in the exterior skin.

8. Storage: During storage, excessive moisture had damaged the modules. This required replacing many interior finishes (floor and ceiling tiles) and repainting, which increased costs.

The existing tower design also had several positive design features. The following observations were made at the Mackall Airfield facility during erection. The overall facility design is simple and straightforward in concept. Troop erection is not required, but could be feasible for the original four-module configuration. The provision of supply air almost 360° around the cab at the window base appeared to be a good feature, if there were enough velocity and throw for proper air mix. Although considered "too large," the large, single vertical chase for all utilities was well placed for both initial installation and access for utility maintenance. One major design problem, however, was the cab size, which was only about two-thirds of the tower area due to the stairway placement.

3 REQUIREMENTS DEVELOPMENT

Format

This chapter documents the following design inputs on which the prototype concept design is based:

1. Issues and assumptions
2. Activities, personnel, and equipment
3. Requirements
4. Criteria
5. Guidance.

The guidance drawings provided on pp 15-25 represent only a graphic interpretation of the requirements and criteria; they should not be considered as definitive design solutions.

function

BACKGROUND:

A recent assessment of the extent of U.S. Army requirements for air traffic control towers has revealed a need for an improved Type III ATCT that is more readily demountable, storable, and transportable. In addition, the assessment has indicated that operations and maintenance improvements should also be developed to accommodate the current electronic communication and radar equipment installed at tower sites. There is, at present, no definitive U.S. Army Type III ATCT design that can be installed at the sites scheduled to obtain towers over the next 5 years.

Objective

The objective is to develop a Prototype Concept Design for a U.S. Army Type III ATCT. The focus will be on the generation of a tower facility that can be factory-built and stored so that it can be readily transported and erected at any site, worldwide, requiring air traffic control operations. The design solution will specifically address:

a. Tower functional requirements of

- 1) Operations
- 2) Maintenance
- 3) Personnel training

b. Storage and transportation conditions for

- 1) Land
- 2) Sea

c. Erection procedures at U.S. Army installation and remote locations

d. Component material and system options

e. Industrialized building manufacturing concepts reflecting

- 1) Design standardisation
- 2) Production considerations

f. Facility acquisition procedures.

The Type IIIa Air Traffic Control Tower (ATCT) is a self-contained, land- and sea-transportable building system providing the weather advisory, land line (telephone), and radio communications facilities necessary for VPA (Visual Flight Rules) control of aircraft within the controlled airspace and terminal area of any airfield. Designed and built for the United States Army, the system accommodates three controllers.

policy / sop

1. With a three-person team, the controllers are seated at the three console positions in the tower: local, data, and ground. The controller in the local position will assume control of arriving and departing aircraft; the person at the data position can update flight strips and coordinate visual and instrument flight; the ground controller covers departure clearances and ground traffic.

issues and assumptions	
<p>1. Applications of U.S. Army Type III ATCT</p> <p>The ATCT Type III fulfills the requirements for a terminal operating autonomously and deployable as a typical ground control approach radar facility. Its utility is that it functions where fixed air traffic control facilities are inadequate or not available. Particular applications can be:</p> <ol style="list-style-type: none"> Replacement for obsolete facilities. Newly acquired small combat airstrips. Large barebase airstrips in a tactical deployment. Rapid deployment to civil or military airfields in times of emergency Training and mobility exercises. Temporary replacement for fixed ATC facilities under repair. Natural or civilian disaster relief operations, floods, earthquakes, fires, storms, etc. <p>2. Deployment Locations</p> <p>The facility design is to apply to a range of environmental conditions commensurate with worldwide deployment potential. That range will be defined according to Air Traffic Control Activity deployment requirements and reasonable application of a single basic tower design. Deployment locations currently under consideration are:</p> <ol style="list-style-type: none"> Wainwright Air Field, AK Bryant Air Field, AK Pt. Drum, NY Pt. Rucker, AL Pirmasens, GER Wertheim, GER Bad Toltz, GER <p>3. Design</p> <p>A new Type IIIA ATCT design will be developed based on user input, evaluation of existing installations, and the appropriate criteria from the existing tower design. Significant items are:</p> <ol style="list-style-type: none"> Air traffic control functions and their immediate support functions will be elevated. Equipment maintenance, parts storage, break and relaxation facilities, and personnel training functions will be accommodated at ground level. 	

activities	personnel	equipment
<p><u>Roof Level</u></p> <ol style="list-style-type: none"> Adjust antennas Maintain warning lights Replace equipment Replace for obsolete facilities. Newly acquired small combat airstrips. Large barebase airstrips in a tactical deployment. Rapid deployment to civil or military airfields in times of emergency Training and mobility exercises. Temporary replacement for fixed ATC facilities under repair. Natural or civilian disaster relief operations, floods, earthquakes, fires, storms, etc. <p><u>Cab Module</u></p> <ol style="list-style-type: none"> Air traffic control (tracking, monitoring, communications, weather reporting) Tower-to-ground communications Observation (air) Observation (ground) Training and supervision Access to roof Ingress/egress Window shades (4 sides) Chalkboard/blackboard Water cooler Fire extinguisher <p><u>Support Module</u></p> <ol style="list-style-type: none"> Billet use (cab personnel only) Cleaning material storage Ingress/egress Limited food preparation Water closet and lav. HVAC unit(s) for cab and support module Electrical panel and switchgear Water heater Free-standing lockers Kitchenette unit Water heater 	<p>No permanent workstation</p> <ol style="list-style-type: none"> 1 UHF/VHF collinear antenna 3 VHF/FM antennas 1 HF antenna and coupler 1 anemometer Lightning rod <p>Normal: up to 3 controllers with 1 supervisor = up to 4 Max: 3 trainees, 3 controllers, with 1 supervisor = up to 7</p> <ol style="list-style-type: none"> 4 control equipment console w/headsets and microphones 2 light signal guns and reels 2 sets binoculars 2 telephone unit Log books, flip books 3 controller chairs: 2 high and 1 low 10. <p>No permanent workstation</p> <ol style="list-style-type: none"> 1. Toilet use (cab personnel only) 2. Cleaning material storage 3. Ingress/egress 4. Limited food preparation 	

Issues and assumptions	<p>b. The tower "cab" floor will be evaluated to a height of 50 ft above-grade. The capability of achieving a cab floor height of 30, 40, or 50 ft with a single basic tower design will be examined and, if feasible, incorporated into the design.</p> <p>c. Interior elements will be arranged to optimize current and future operational efficiency, per Air Traffic Control Activity requirements.</p> <p>d. Departure from standard Army construction criteria may be appropriate in some cases. Criteria requiring waivers will be identified.</p>
Procurement	<p>4. Procurement</p> <p>The tower structures will be procured in volume from a single source. It is currently anticipated that an initial procurement will be about 20 units. Each ATCT "package" will be complete and ready to erect except for electronic communication/control equipment.</p>
Transportation	<p>5. Transportation</p> <p>Tower modules and components will be designed and fabricated to be transportable by truck and sea freight. Transportation by air will be accommodated if required by Air Traffic Control Activity. It is assumed that overseas transport will be by Government carrier.</p>
Cost	<p>6. Cost</p> <p>It is anticipated that Type IIIA ATCTs will be purchased and erected with QDMA funds, on which a cost ceiling of \$200K is imposed. A cost target of \$200K will be considered during design development. If it becomes apparent that a suitable facility cannot be procured and erected for \$200K, that situation will be identified, and a cost estimate will be provided.</p>

requirements

criteria

Roof Level

1. Support equipment
2. Allow personnel access
3. Support personnel
4. Protect/contain personnel
5. Allow roof drainage

Cab Module

1. Provide adequate space/area
2. Support equipment and personnel
3. Accommodate equipment/operational items
4. Allow horizontal visibility
5. Allow vertical visibility upwards and downwards
6. Prevent obstructions to visibility
7. Maintain instrument/console visibility
8. Maintain interior environmental control
9. Maintain interior acoustical control
10. Allow roof access
11. Provide ingress/egress
12. Provide alternative means of emergency egress

1. a. Antenna point load: negligible
b. Lightning rod point load: 200 lb (est.) --- guy at roof corners
2. a. Access from cab interior
3. b. Roof scuttle: 24 x 36 in. min.
c. Disappearing stairs or removable ladder
4. a. Live load: per location (20 to 40 psf)
b. Prevent damage from foot traffic
5. a. Guard rail: 42 in. high, 3-rail w/foot plate below or equivalent configuration
b. Roof pitch: 1/2: 12 min
c. Drain to exterior, remove runoff w/downspout
c. Downspout flush w/mullion or corner column
1. a. Cab exterior dimensions: 12 x 16 ft
b. Minimize intrusion of window sill into interior space
c. Accommodate 4 consoles side by side; 24 in. wide x 27 in. deep x 40 in. high (at back), 31 in. high (at front) each
d. 3-in. clearance required behind console
e. Min. clearance in front of console: 5 ft (one person seated at console, one standing behind seated controller)
f. Ceiling height: min. 7 ft 6 in., max. 8 ft 0 in.
g. Minimize intrusion of stairs into interior space
2. a. Floor live load: 100 psf
b. Hang signal light guns from ceiling; conceal reels in ceiling
3. a. Provide casework for logbooks, flipbooks, technical literature, and binoculars; at or near control console
b. Provide casework for personal items
4. a. Field of vision:
b. Floor height: 30 ft (w/40 ft and 30 ft possible)
c. No definitive criteria for visibility angles, upwards or downwards
5. a. Window sill heights: about 42 to 48 in.
b. Ceiling height: 7 ft 6 in. - 8 ft 0 in.
c. Access to entire cab perimeter desirable but not required
6. a. Minimize window mullion and column width (no definitive criteria)
b. Avoid obstructions at windows make drainpipes, chases, etc., flush w/mullions or columns or part of same
c. Reduce glare: tilt window 15°
7. a. No definitive criteria for instrument lighting or shading
b. Low-watt, direct-down task lighting on console writing surface
c. Interior surfaces: dark color, flat finish
8. a. Heating: 72°F max.
b. Cooling: 74°F max.
c. No dehumidification requirements for electrical equipment
d. Prevent excessive temperature stratification
e. Locate air diffusers to prevent obstruction by control equipment and to prevent direct draft on control personnel
f. Prevent fogging on inside or outside of windows
g. Provide natural ventilation/"economy mode" in HVAC design

Requirements

Criteria	Requirements
Interior Surfaces	<p>9. Interior surfaces: acoustically soft, carpet below sill heights</p> <p>10. a. Removable ladder or disappearing stairs b. Access from cab interior c. If ladder, allow removal to support module or balcony</p> <p>11. a. Minimize intrusion of stairwell into cab interior space b. "Whipple ladder" stair permissible only on last rise into cab; ladder dimensions: Tread width: min. 16 in. between rails Riser: max. 12 in. Tread depth: min. 6 in. Angle of rise: 60° max. Railing: 30 to 34 in. above tread c. Provide smoke barrier between stairwell and cab module</p> <p>12. a. Access to secondary exit from within enclosed cab volume b. Access door min. 2 ft. \times 6 in. \times 4 ft. 0 in. c. Access doors do not require a landing</p>
Support Module	<p>1. Support mechanical, electrical, and personnel loads</p> <p>2. Accommodate mechanical and electrical equipment and distribution</p> <p>3. Accommodate water closet and lavatory</p> <p>4. Provide accommodations for miscellaneous cab equipment</p> <p>5. Provide accommodations for controllers' personal items</p> <p>6. Provide ingress/egress</p>
Balcony	<p>1. Support personnel</p> <p>2. Contain/protect personnel</p>
Stair Module(s)	<p>1. Permit safe vertical access</p> <p>2. Elevate cab and support functions</p> <p>3. Minimize application of single stair module design within and among towers</p> <p>4. Provide access for inspection of electrical conduit, panel boxes, and raceways.</p>

1. Floor live load: 100 psf
2. Provide adequate space for HVAC unit, electrical panel, and switchgear, water heater, mechanical and electrical distribution
3. Provide for HVAC unit fresh air supply
4. Minimize intrusion of panel box and electrical chase(s) into interior space; surface mount metal chase, accessible from interior
5. Min. headroom: 7 ft. 6 in. below suspended ducts, electrical chases, etc.
6. Toilet enclosure min. 2 ft. 8 in. \times 4 ft. 6 in. clear interior dimensions.
7. Minimize intrusion of plumbing chase into interior space.
8. Lavatory need not be within toilet enclosure.
9. Provide lockers for storage of personal items
10. Min. landing clearance 33 in. at head of stairs
11. Provide kitchenette unit w/sink, base cabinets, and wall cabinets

1. Floor live load: 100 psf (verify)
2. a. 3 ft 6 in. - 4 ft 0 in. width
b. Guardrail: 42-in., 3-rail, w/o plate below

1. a. Stair dimensions:
Tread width: min. 30 in. clear
Landing length in direction of travel: 33 in. min.
Tread depth min.: 9 1/2 in.
Riser max.: 8 in.
Rail height: 30 to 34 in.; intrude max. 1 1/2 in. each side over tread
b. No door to open immediately into stairs without landing
c. Doors open in direction of exit
d. Interior materials to be noncombustible
2. Capability of 50 ft (w/40 and 30 ft possible) cab floor height
3. a. permit interchange of second-, third-, and fourth-story modules within a tower and among different towers

requirements

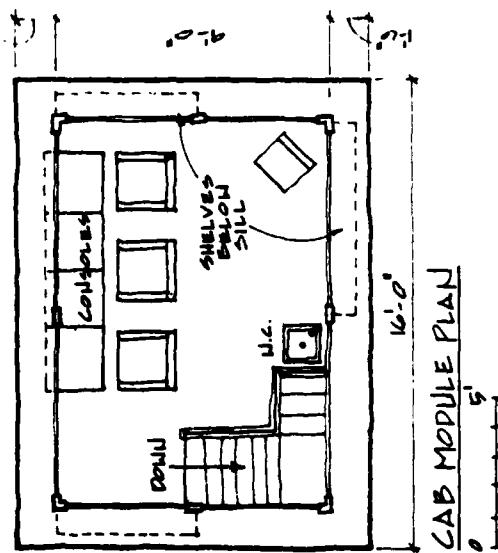
Base ATC Operations Bldg.

1. Provide adequate space, area, and accommodations for radio, control, and recording equipment
2. Provide adequate space, area, and accommodations for equipment repair and parts storage functions
3. Provide adequate space, area, and accommodations for briefing and training functions
4. Provide adequate space, area, and accommodations for break and food preparation functions
5. Provide adequate space, area, and accommodations for toilet functions
6. Provide adequate space, area, and accommodations for environmental control (of equipment module)
7. Maintain fire safety regarding tower structure
8. Support equipment and personnel loads
9. Maintain design, fabrication, transportation and erection characteristics of tower structure modules.

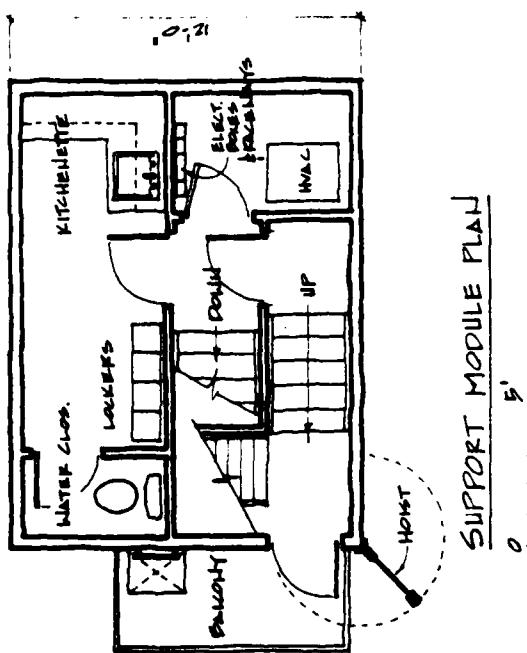
1. a. Provide space for 3 equipment racks 22 x 22 in. each; 4 ft clearance in front
 - b. Provide space for 1 recorder, 20 x 26 in., access to all four sides
 - c. Locate equipment room to facilitate equipment interface with tower structure
 - d. Minimize intrusion of electrical hoses and panel boxes into spaces; recess or surface mount
 - e. Headroom min. 7 ft 6 in. below suspended chases
2. a. Provide space for repair table (min. 26 x 36 in.) and chair
 - b. Provide space for 2 free-standing 18 x 36 in. closet/cabinet units
 - c. Provide task illumination for work table
3. a. Briefing room to accommodate 12 seated people, table/deck (24 x 36 in. min.)
 - b. Provide chalkboard/blackboard
 - c. Briefing room may be combined w/break functions
 - d. Briefing room and office may be separate modules to be added later
4. a. Provide kitchenette counter unit, min. 24 x 60 in. w/sink, base cabinets, and wall cabinets
 - b. Provide space for 32-in. round table w/4 chairs (if break room separate from briefing room)
5. a. Enclose toilet and lavatory fixtures
 - b. Provide accommodations for cleaning materials
6. a. Heating: 68°F max.
 - b. Cooling: 78°F min.
 - c. Locate air diffusers to prevent obstruction by electrical equipment
 - d. Provide natural ventilation/economy mode" in HVAC design
7. a. Provide "smoke-free" connection with tower structure
 - b. Provide weather protection between tower and equipment modules
 - c. Provide accessible chase between tower and equipment modules
8. a. Floor live loads: 100 psf
9. Design equipment module to be supplied in same "package" as tower structure, by same supplier

guidance

guidance



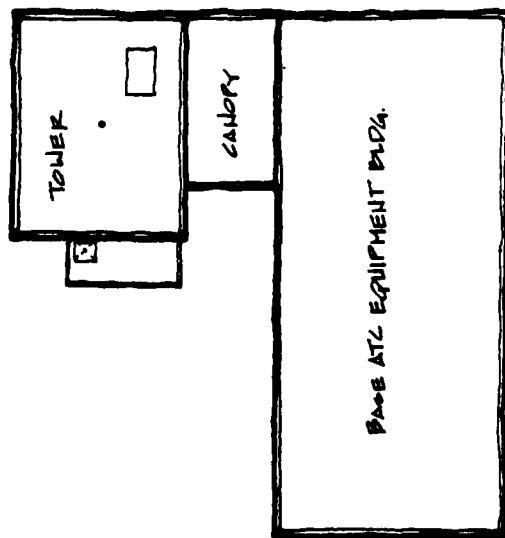
CAB MODULE PLAN



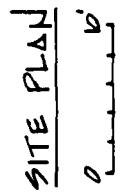
SUPPORT MODULE PLAN

guidance

guidance

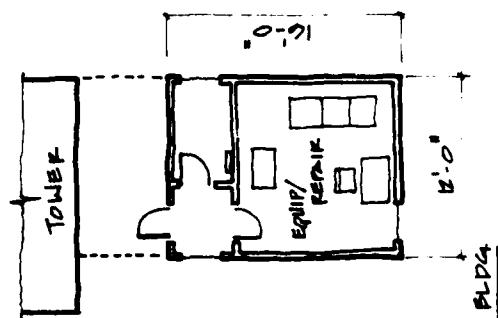


BASE ATC EQUIPMENT DADA

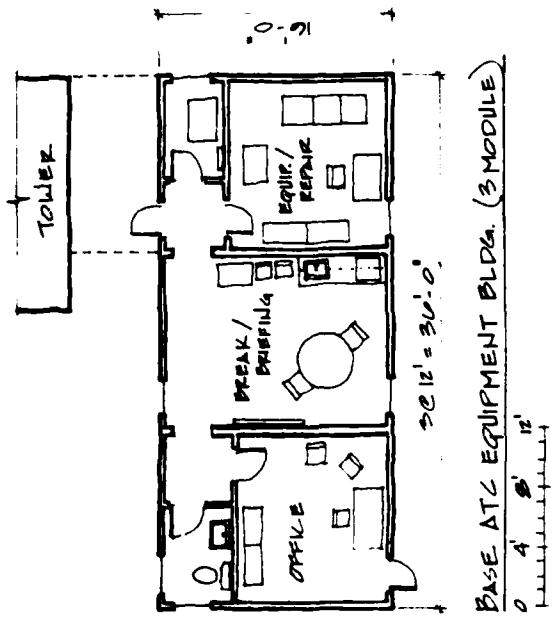


SITE PLAN

guidance

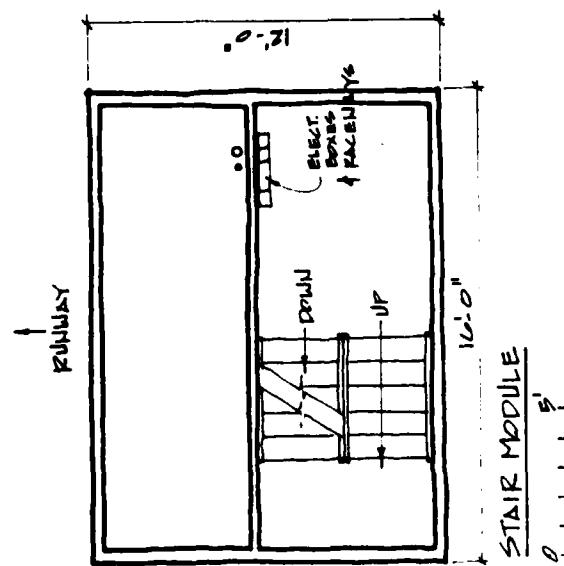


BASE ATC EQUIPMENT BLDG.

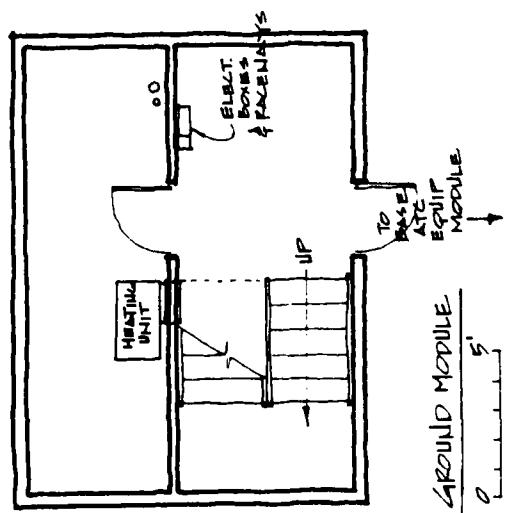


BASE ATC EQUIPMENT BLDG. (3 MODULE)

guidance

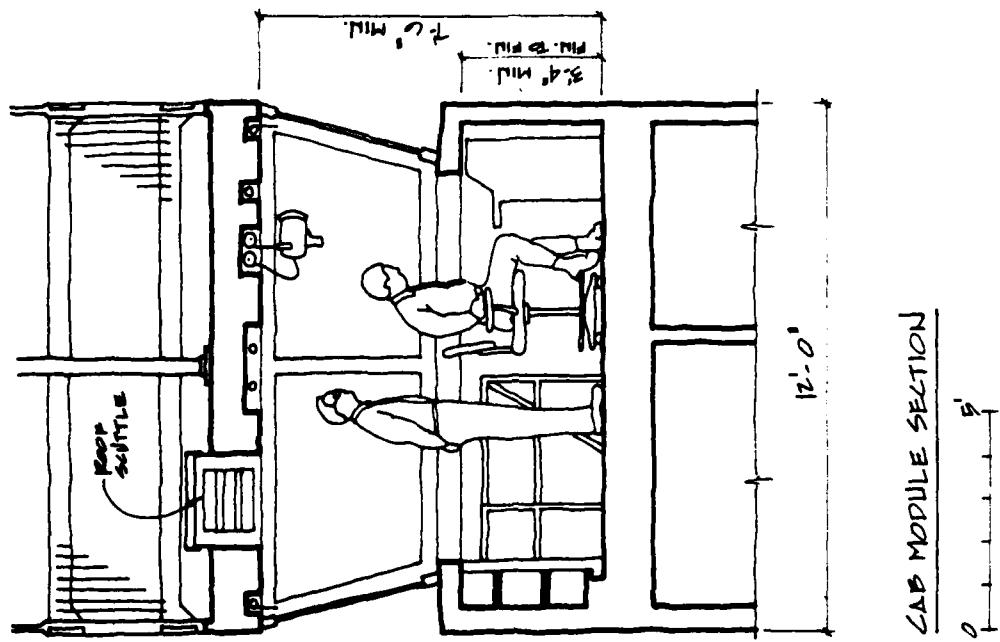


STAIR MODULE



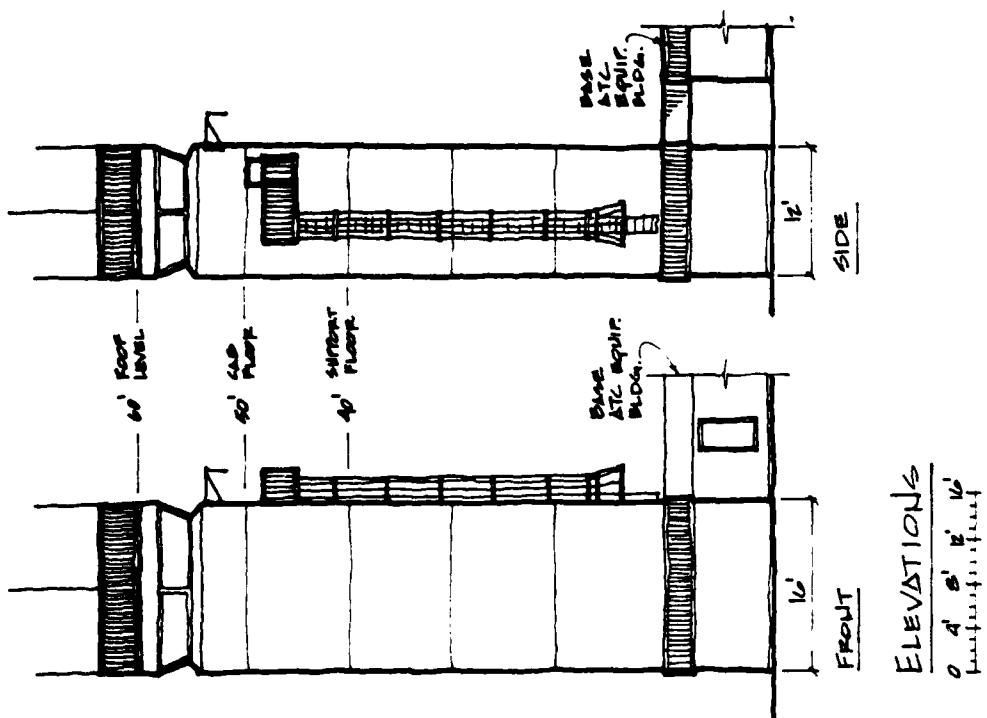
GROUND MODULE

guidance



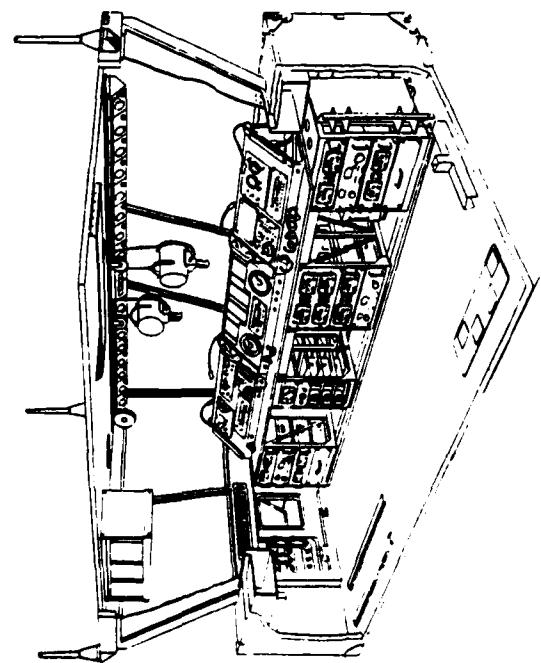
CAB MODULE SECTION

guidance



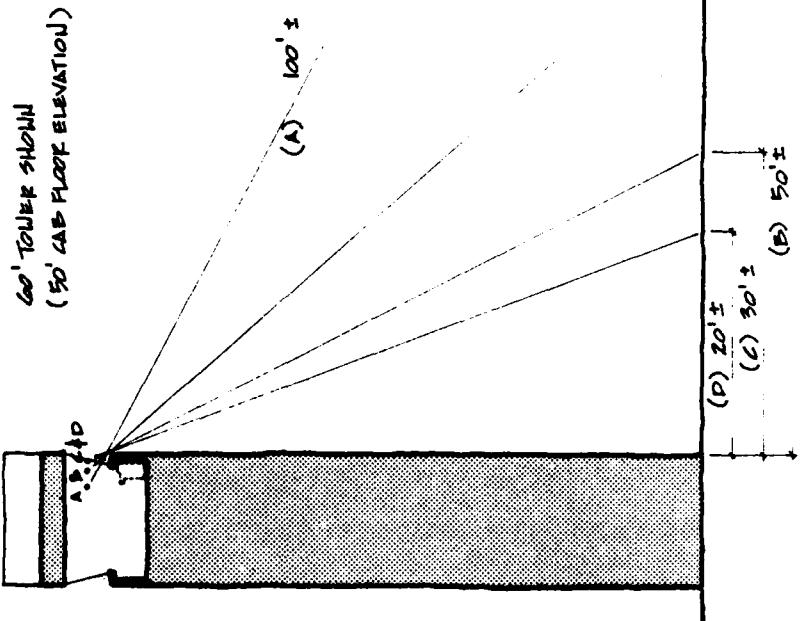
ELEVATION

guidance



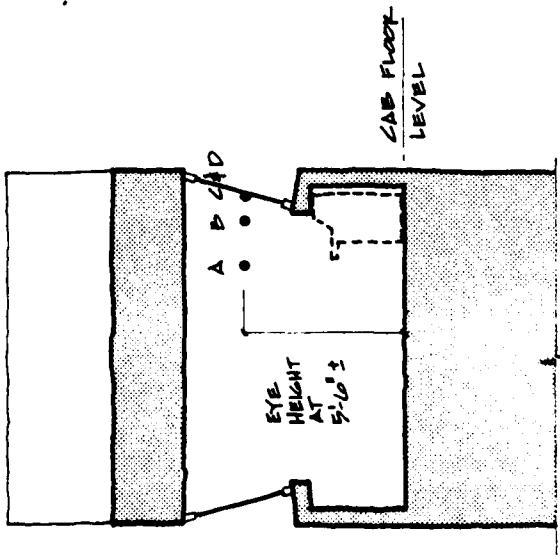
guidance

guidance



CAB-TO-GROUND LINES OF SIGHT

guidance



Position 'A' - STANDING AT CONTROL CONSOLES
Position 'B' - STANDING AT WINDOW SILL EDGE
Position 'C' - STANDING AT WINDOW SILL EDGE - LEANING FORWARD
Position 'D' - SAME AS POSITION 'C' WITH EXTERIOR SILL EDGE BEVELED

CAB-TO-GROUND VIEWING POSITIONS

4 DESIGN DEVELOPMENT

Prototype Concept Design

The following represents the Prototype Concept Design for a U.S. Army Type IIIa ATCT. The drawings on pp 31-81 represent a standard architectural design for future Type IIIa ATCT construction. Chapters 5 through 8 describe construction and facility acquisition approaches for completing the concept; however, this specific design can also be executed using other construction approaches.

Construction Systems Description

The general configuration of the Type IIIa ATCT facility is a 60-ft control tower (50-ft cab floor elevation) housing ATC activities and limited personnel support functions. An adjacent, ground-level Base ATC Operations Building houses ATC equipment and repair activities. This building can be expanded to include office/toilet and break/briefing spaces.

Both the control tower and the Base ATC Operations Building will be pre-fabricated, transportable, steel-frame modules of 12 ft by 16 ft by 10 ft high. The control tower will be constructed using vertically stacked modules. A typical configuration will consist of a ground module that provides entrance into the tower and access to the stairs; up to three identical and interchangeable intermediate stair modules; a support module that provides mechanical, toilet, and limited food preparation functions; and a cab module that houses the actual air traffic control functions. The overall tower can be 40, 50, or 60 ft tall, depending on the number of stair modules used.

The Base ATC Operations Building will be constructed by arranging modules adjacent to one another. A typical configuration will consist of an equipment/repair module, a break/briefing module, and an office/toilet module. Each installation's requirements will determine the combination and arrangement of modules.

Where possible, the modules should repeat the same basic structural configuration for both the control tower and the Base ATC Operations Building. Each module of the Base ATC Operations Building should have the same general exterior configuration to allow various combinations of modules, as needed for a specific location.

Deployment and Erection Scenario

It is anticipated that, once the control tower and Base ATC Operations Building modules are fabricated, the Government will procure, store, deploy, and erect them as needed. If so, site preparation, foundation/slab work, and actual erection will not be considered part of this design and fabrication. Alternatively, the ATCT structures may be erected immediately after fabrication; in this case, they could be delivered directly to their sites. Initial procurement will probably be 10 to 12 complete Type IIIa ATCT facilities.

Facility Construction and Materials

Unless otherwise indicated, the following item descriptions pertain to both the control tower and the Base ATC Operations Building.

Superstructure

The structural design will accommodate the following live loads, which represent the most severe conditions found in locations where tower deployment has been identified.

Roof	55 psf
Floor, stairs, balcony	100 psf
Wind	95 mph
Seismic	Zone 4

The tower will have a steel-frame superstructure with light-gage metal joists and a metal deck for the floors and roof. Fire-retardant plywood subflooring will prevent direct thermal conductance from the finish floor to framing members exposed to the exterior. Although no specific framing or detailing will be specified, use of structural tube members should provide the most convenient solution. For all tower sections except the cab top, the frame sections can be fabricated as identical units. Configuration of the Base ATC Operations Building can be similar.

All modules used in the control tower will be able to withstand 60-ft-high stacking combinations. The tower's ground module will anchor to a site-constructed, poured-in-place concrete foundation system.

Exterior Walls

Exterior walls will consist of insulated metal sandwich panels with baked-on color finish. The panels will provide a maximum U-value of .05. Fasteners will be concealed from the exterior. Wall panel materials and construction requirements will address thermal, air, and water transmission for the panel itself, as well as interface with other panels, the superstructure, and any attached items, such as doors, window vents, penetrations, and surface-mountings. Gasketing, caulking, and/or flashing will be used to prevent air and water infiltration. Exterior wall panels or closure pieces will cover structural members to prevent thermal bridging to the interior. The basic building will have a light, neutral color. Trim pieces, fascia, doors, and other ancillary items will be painted or prefinished in complementary colors.

Roof/Roofing

The roof will be either a metal panel system or single-ply membrane roofing and will be drained toward the perimeter to prevent ponding. Run-off will be channeled directly to vertical storm leaders or downspouts. Sloping the roof structural members or contouring the roof insulation will allow positive roof drainage. Curbing, flashing, gutters, drains, downspouts, and all other accessories will be provided as an integrated system. To minimize visual interface from within the cab, one rear corner column in the control tower will incorporate a downspout. Below the cab module sill, a downspout will carry drainage to ground level. The roofing will accommodate foot traffic as

well as provisions for mounting the tower's lightning rod and will provide a maximum U-value of .05. All Base ATC Operations Building module roofs will be designed to allow placement of adjacent modules. Rainwater will be drained either by interior drainage or by exterior gutters and downspouts.

Floors

The tower's ground-level floors will be concrete slab-on-grade (site-installed). The Base ATC Operations Building's floors may be either concrete slab-on-grade or integral with the module. Floors above-grade over non-conditioned spaces will provide a maximum U-value of .05.

Doors and Windows

All doors and frames will be of standard metal, and will be primed and painted. Insulated cores will be provided in all exterior doors and in all interior doors at the tower support module level that lead into the kitchenette area and the cab module. Entrance to both the Base ATC Operations Building and the tower will be intercom-controlled from the cab module. All window frames and sashes will be made of standard steel or aluminum and be operable. The Base ATC Operations Building module will have casement windows, and the tower cab module will have top-hinged, in-swinging windows to permit cleaning from the interior. All windows will be double-glazed with thermal-break frames. All steel frames and sashes will be primed and painted, and all aluminum frames and sashes will be anodized.

Interior Partitions

Interior partitions will be metal-skinned, panel-types similar to the exterior walls, or prefinished panels attached to metal stud framing. Interior partitions that enclose conditioned spaces in the tower will be insulated.

Interior Finishes

All floor finishes will be vinyl asbestos tile or sheet vinyl flooring, except the control tower cab floor, which will be carpeted, and the tower ground floor, which will be sealed concrete. A vinyl base will be used throughout both the tower and the Base ATC Operations Building. Carpeting in the tower cab module will extend up the walls to provide acoustic control. All other wall surfaces for both the control tower and the Base ATC Operations Building will be metal panel with baked-on color finishes. The ceiling in the tower cab module will be acoustical tile, and the ceiling in the tower support module kitchenette/toilet room will be suspended acoustical tile. All other ceilings in the tower will be unfinished. All ceilings in the Base ATC Operations Building will be suspended acoustic tile and will be a minimum of 7 ft, 6 in.

Case Work

Built-in shelving in the control tower cab module will provide space for logbooks, flipbooks, technical literature, and personal items. The shelves will be recessed under the window sills, occupying otherwise unused space. Shelving material may be wood or metal; wood casework and trim items will be painted or varnished.

Stairs, Balconies, and Railings

All stairs, balconies, and railings will be standard steel configurations. The control tower stair will be an open-riser type with steel grating or tread plate for treads and landings. Steel channel stringers will be used to frame the landings and stair runs. Stair width will be a minimum of 30 in., and stair railing height will be 30 to 34 in. The tower fire escape balcony will be 42 to 48 in. wide with a 42-in.-high guardrail. The control tower fire escape ladder and protective cage will be made of steel, and there will be a 42-in.-high guardrail at the tower roof level. Both the roof and fire escape guardrails will be vertical-bar type to complement the appearance of the fascia. A wood or aluminum "hideaway" stair in the tower cab module ceiling will provide access to the roof. To minimize stairwell intrusion into the tower cab interior space, a standard steel ship's ladder will be permitted for the last rise into the tower cab. The railing in the tower cab will be removable to facilitate moving of equipment into and out of the cab.

Mechanical Systems

The HVAC system for the control tower will be an electric, forced-air furnace and air-conditioning unit located in the support module below the cab. Air distribution to the cab will be through linear diffusers located at the window sill and blowing over the window surfaces. Ceiling diffusers will supply the support module. Both levels may be treated as a single zone with thermostat control located at the cab level. Any additional adjustment of the support module environment will be by diffuser damper, as conditions require. A single HVAC unit can accommodate all locations for which deployment has been indicated. The tower stairwell will be heated by an electrical unit in winter and ventilated as required during the summer. A similar HVAC unit will service the Base ATC Operations Building. The distribution system will accommodate the modular/interchangeable nature of all possible base module configurations. All grills and louvers that penetrate exterior walls or roofs will be bird- and weatherproof.

Electrical

The electrical configuration is conventional and reasonably straightforward. Each module will have its own panel box, and each circuit will be unique to the module. Electrical distribution will be surface-mounted on walls and concealed above finished ceilings. Cab lighting will be low-wattage, recessed, incandescent downlights located over the control consoles. A recessed fluorescent fixture will provide lighting during nonoperational hours. Fluorescent and incandescent lighting will be used for the support module and the Base ATC Operations Building.

An intercommunications system will allow personnel in the tower cab to control access into both the tower and the Base ATC Operations Building. An electric, thermostat-controlled exhaust fan and louver system will be provided in the control tower stairwell for ventilation during the summer. Exhaust fans will ventilate toilet spaces and the break/briefing module. All grills and louvers penetrating exterior walls will be bird- and weatherproof.

Plumbing

Both the control tower and the Base ATC Operations Building will require domestic water supply and a sanitary drain/waste/vent (DWV) system. All plumbing will be located or adequately protected to prevent freezing during the winter. Rainwater drainage will be provided as described on p 33 and will be located to prevent freezing. Plumbing fixtures and accessories will be provided as shown in the drawings and schedules (p 54).

ATC Equipment

The accommodation in the tower structure of ATC equipment, which will be Government-furnished, is critical.

The fiberglass antennae will be mounted on top of the vertical corner post members of the cab roof guard rail. Cables will run directly to weather-head connections located at the base of two guardrail corner post members (see drawing ATC 2, p 74). At this point, the cables will access the interior through the corner posts and the tubular columns below. The cables will enter the cab at two locations and continue traveling vertically through the cab interior via 4-in. flexible metallic conduit (see drawing ATC 4, p 76). Both antenna cables and control console cables will penetrate through the cab module floor to the support module interstitial space below. Where necessary, both antenna and control console cables will travel horizontally within the interstitial space via a horizontal cable trough. All cables will collect at a vertical cable ladder located within the support module mechanical space (see drawings ATC 5 and 6, pp 77 - 78). At this point, all cables will travel vertically, down the tower shaft, and across the canopy into the equipment room in the ATC Base Operations Building. The cables will be accessible at each landing in the tower stairwell (see drawings ATC 7 through 9, pp 79 - 81).

The ATC equipment and repair module houses additional ATC and recording equipment. Three 22- by 22-in. electrical equipment racks are required. These require a 4-ft clearance in front for removal and replacement of equipment. Although they can be installed flush against a wall, backside clearance is also recommended. Room for a fourth rack has been allowed. This equipment is free-standing and requires no anchorage. One 24- by 25-in. recorder is also required and must be accessible to front and back and must be anchored to the floor. However, cable trough drops must be located above each equipment rack and the recorder.

SCHEDULE OF DRAWINGS

A1 Site Plan
A2 Roof Plan
A3 Cab Module Plan
A4 Support Module Plan
A5 Stair Module Plan
A6 Ground Module Plan
A7 Base ATC Operations Building (1 Module)
A8 Base ATC Operations Building (2 Module)
A9 Base ATC Operations Building (3 Module)
A10 Elevations
A11 Elevation and Section
A12 Cab Module Section
A13 Cab Module Sill Design
A14 Cab Module Interior Elevation - Front
A15 Cab Module Interior Elevation - Left Side
A16 Cab Module Interior Elevation - Rear
A17 Cab Module Interior Elevation - Right Side
A18 Support Module Interior Elevation - Front
A19 Support Module Interior Elevation - Left Side
A20 Base ATC Operations Building - Kitchenette
A21 Finish Schedule
A22 Door Schedule
A23 General Equipment and Accessory Schedule
A24 Stair Layout

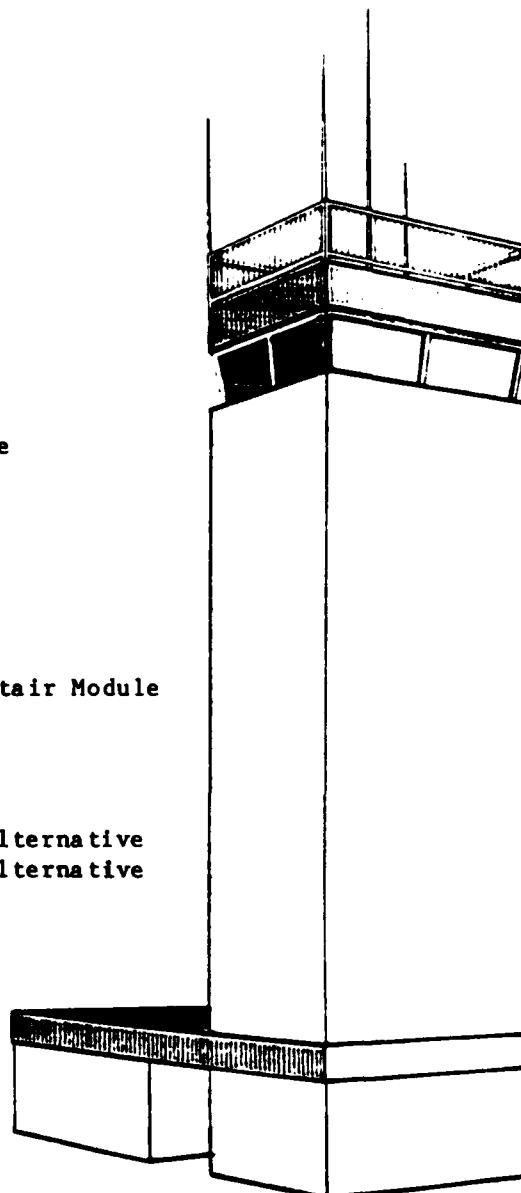
M1 Cab Module - HVAC Plan
M2 Cab Module Section - HVAC Supply & Diffuser
M3 Interstitial Space - HVAC Plan
M4 Support Module - HVAC Plan
M5 Alternative HVAC Unit Positioning
M6 Base ATC Operations Building - Interstitial Space

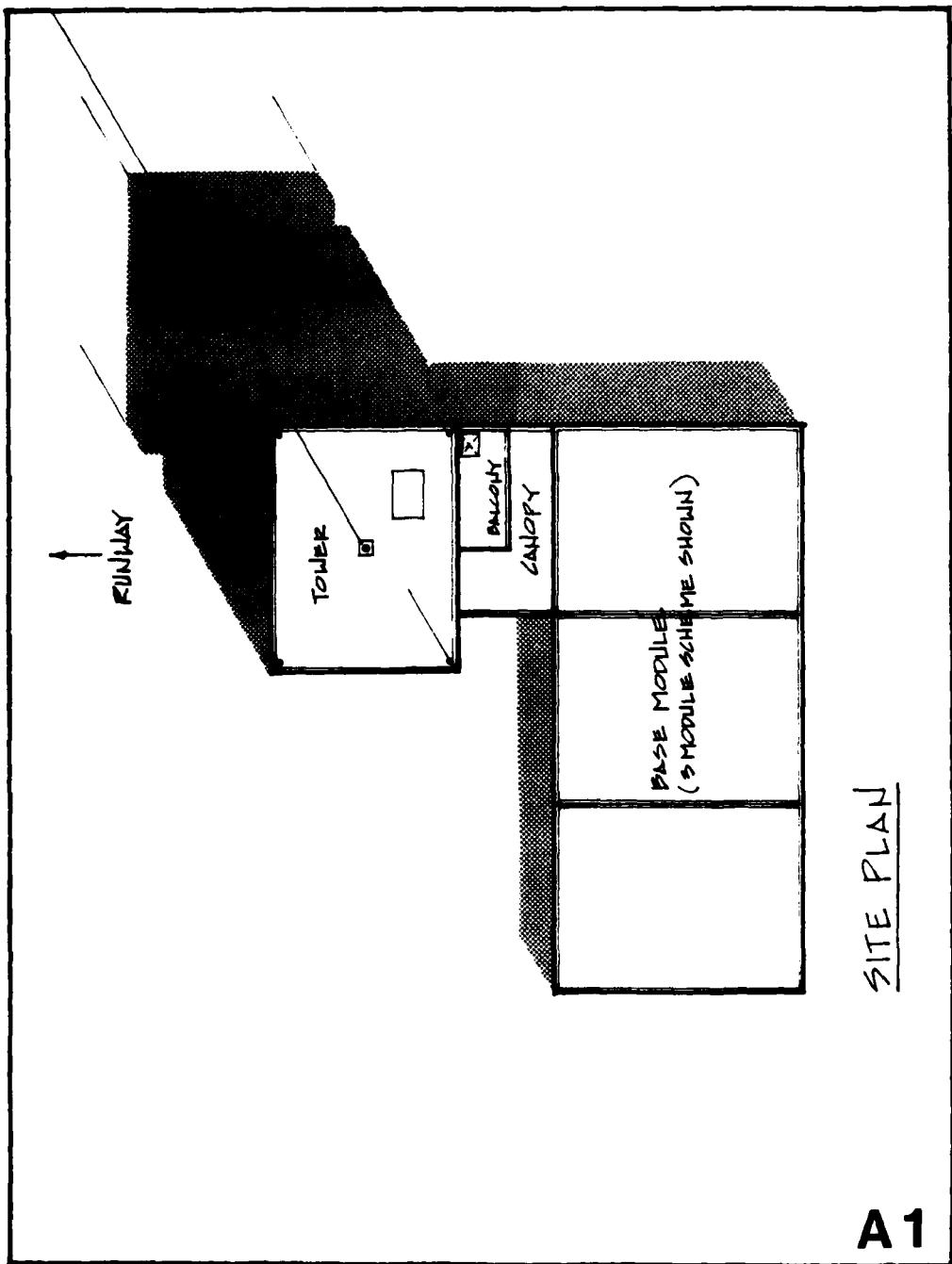
P1 Schematic Sanitary Plumbing Diagram

E1 Cab Module - Electrical Plan
E2 Support Module - Electrical Plan
E3 Stair Module - Electrical Plan
E4 Ground Module - Electrical Plan
E5 Typical Electrical Distribution Per Individual Stair Module
E6 Base ATC Operations Building - Electrical Plan

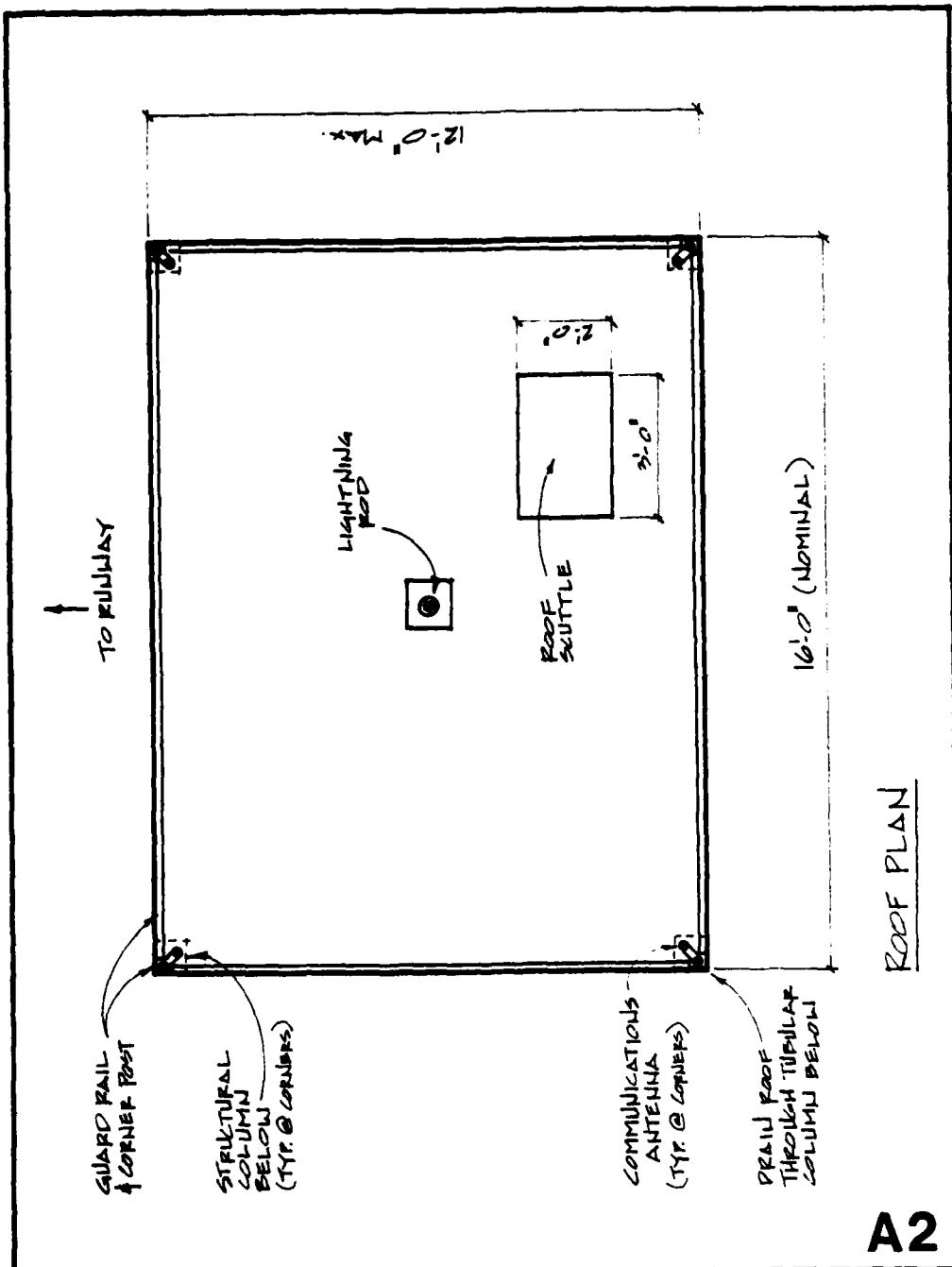
S1 Structural Framing Schematic Alternative
S2 Structural Framing Schematic Alternative
S3 'H' Frame Cab & Support Module Only Deployment Alternative
S4 Box Frame Cab & Support Module Only Deployment Alternative

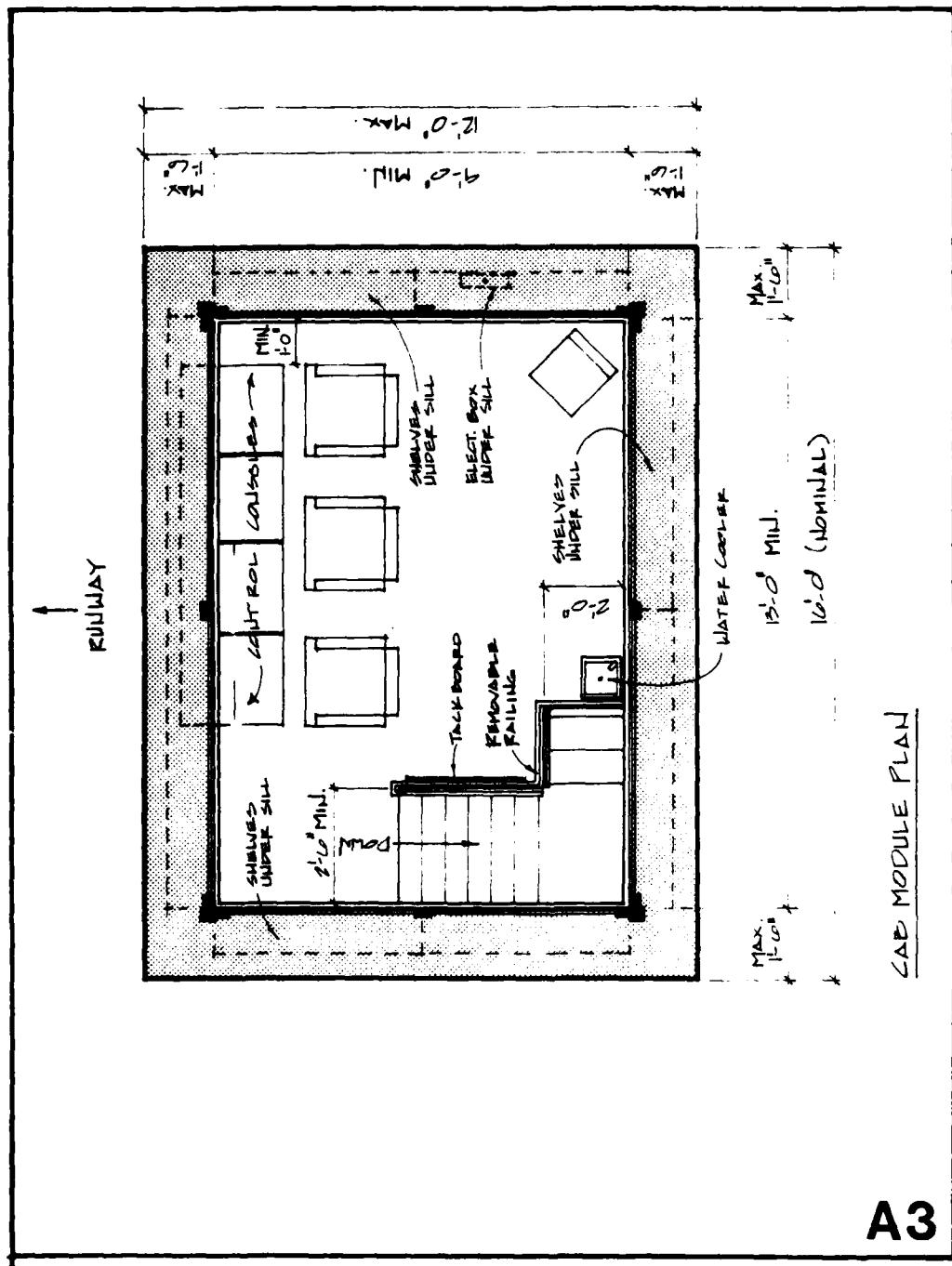
ATC1 ATC Equipment Schedule
ATC2 Roof Plan - Weatherhead Locations
ATC3 Detail - Antenna Mount/Weatherhead
ATC4 Section - Cable Travel Through Cab Module
ATC5 Support Module - Interstitial Space
ATC6 Support Module - Floor Plan
ATC7 Stair Module - Typical Floor Plan
ATC8 Ground Module - Floor Plan
ATC9 Base ATC Operations Building



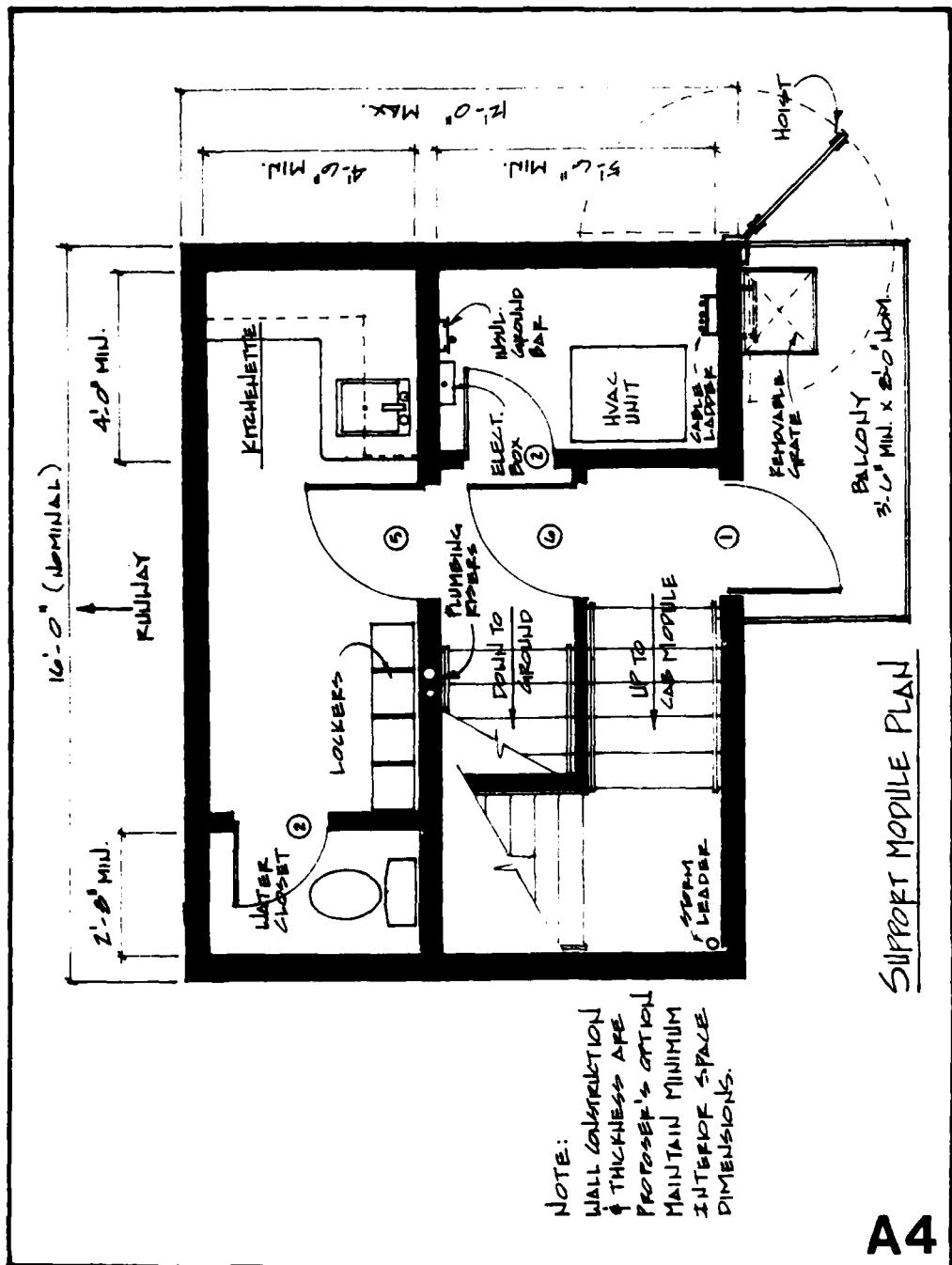


A 1



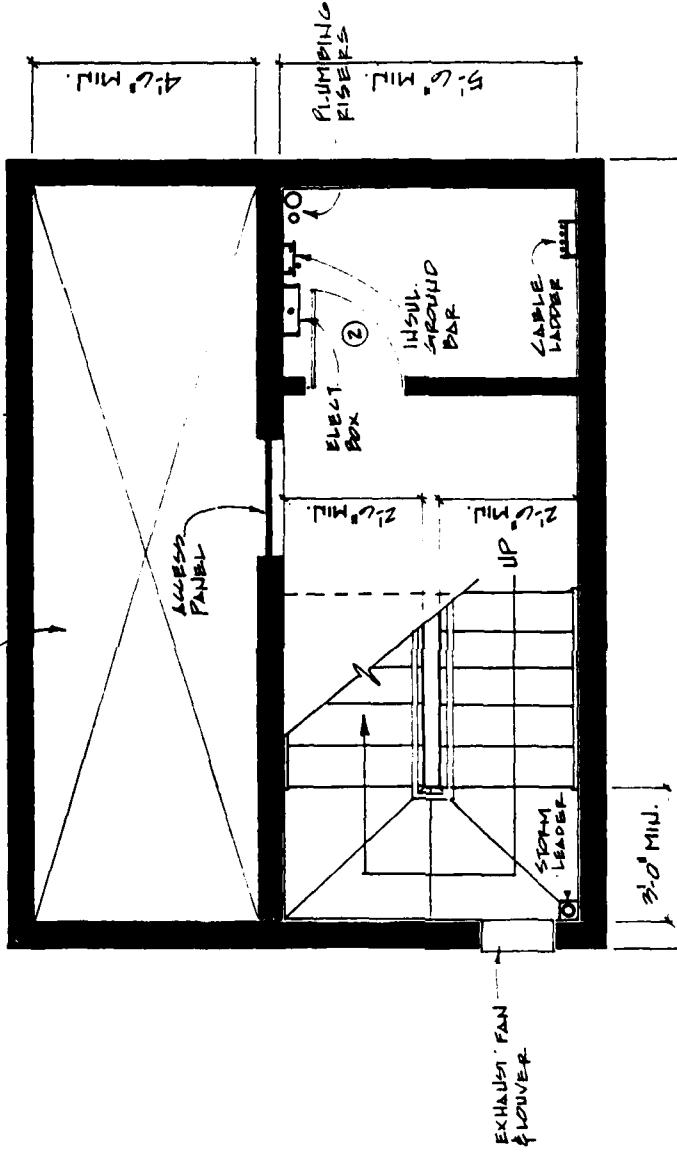


A3



A4

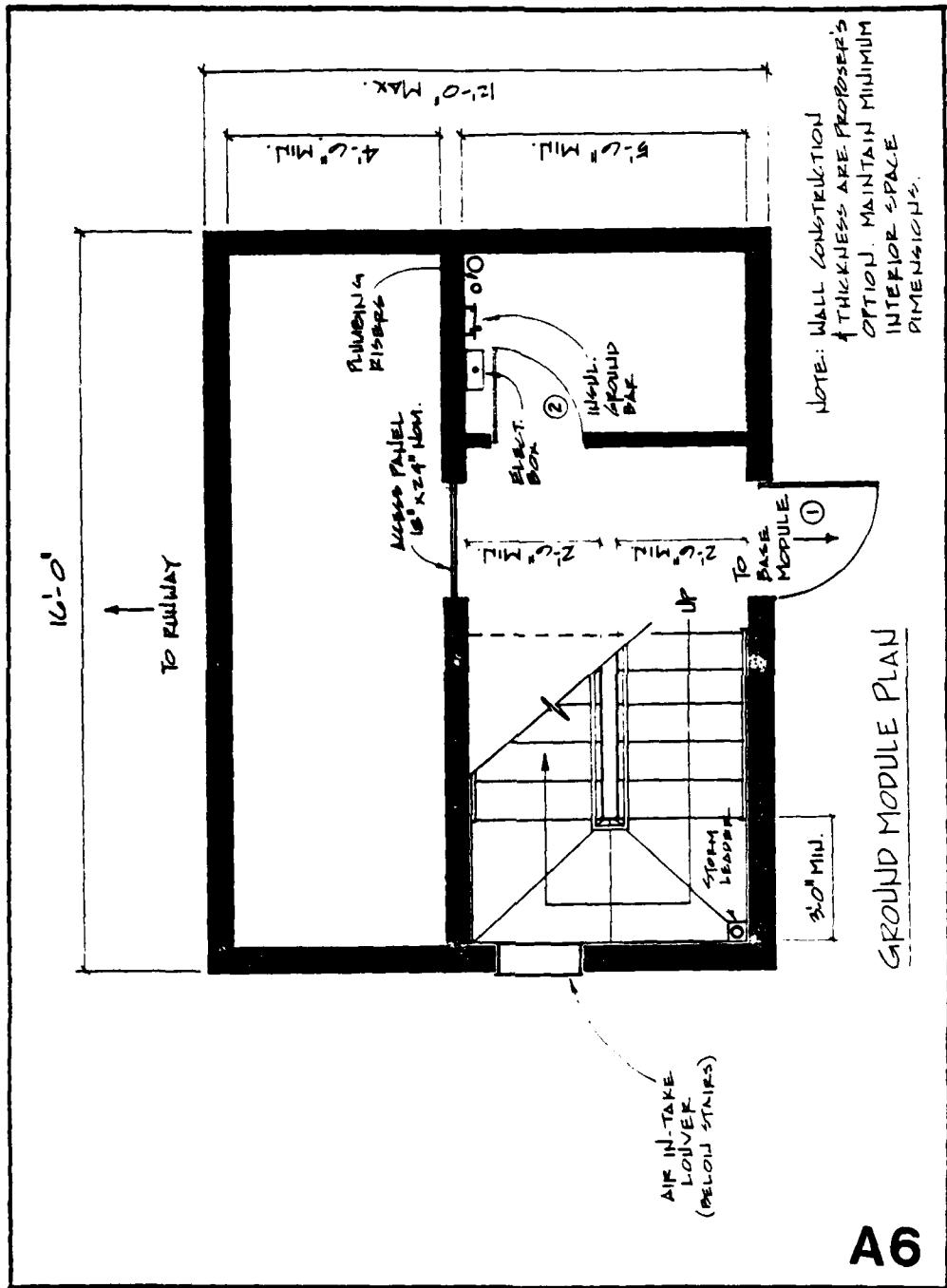
THIS AREA MAY BE OPEN TO THE GROUND. IF FLOOR FRAMING IS FRAMING & RECK IS RETAINED, PROVIDE MIN. 18" x 24" ACCESS PANEL FROM LANCIUS TO RUMBLE



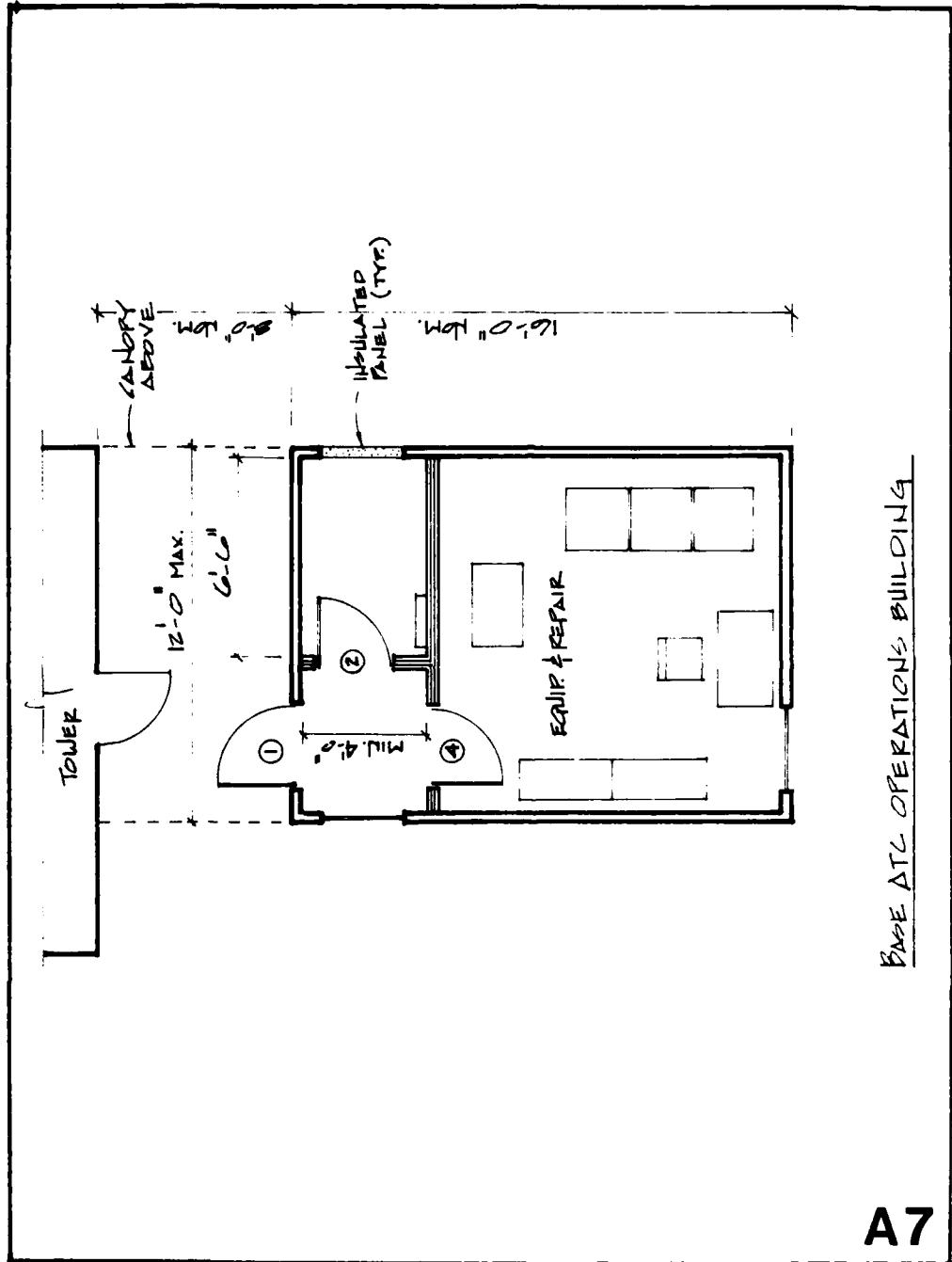
A5

NOTE: WALL CONSTRUCTION & THICKNESS ARE PROPOSER'S OPTION. MAINTAIN MINIMUM INTERIOR SPACE DIMENSIONS.

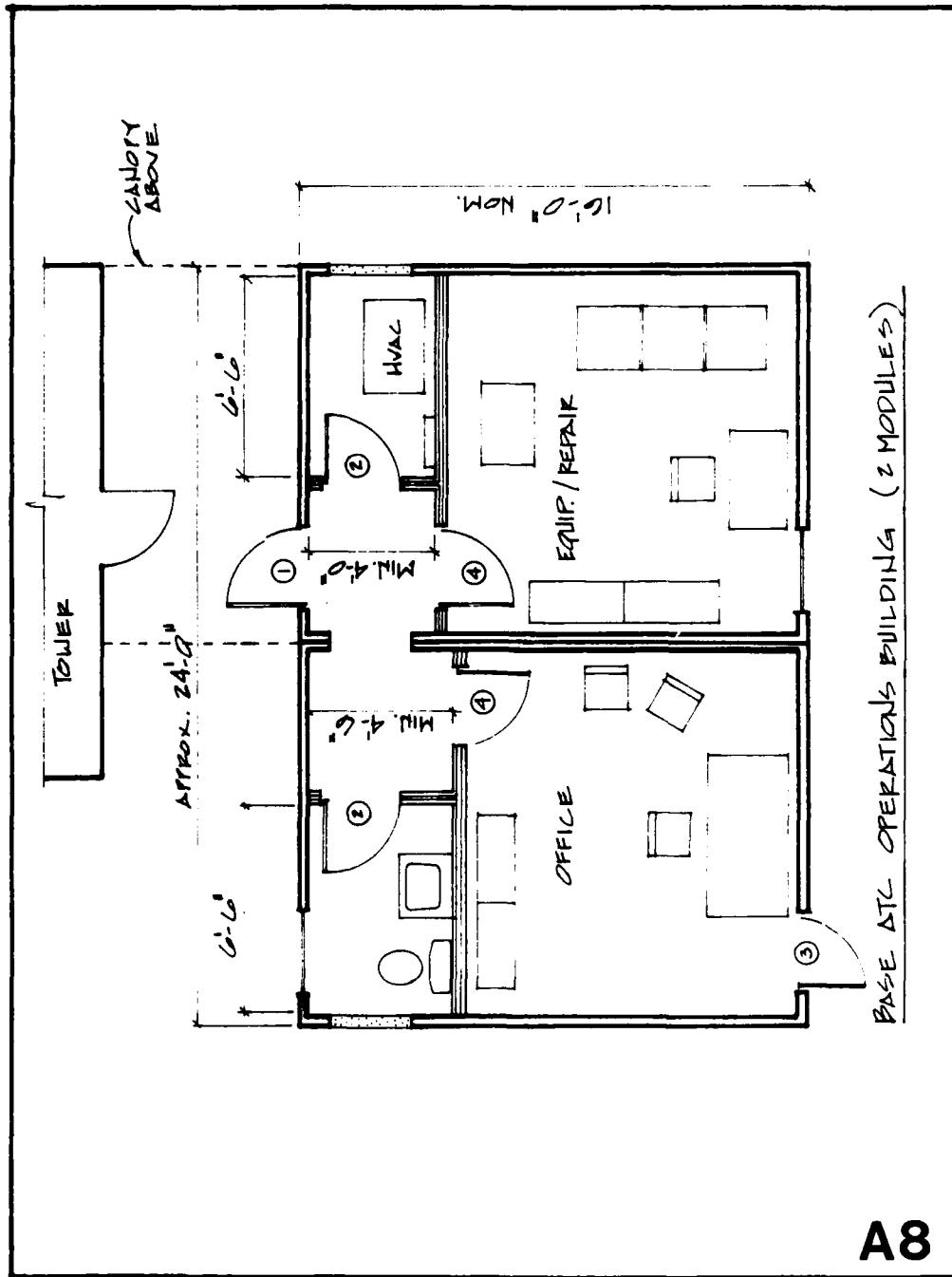
STAIR MODULE PLAN



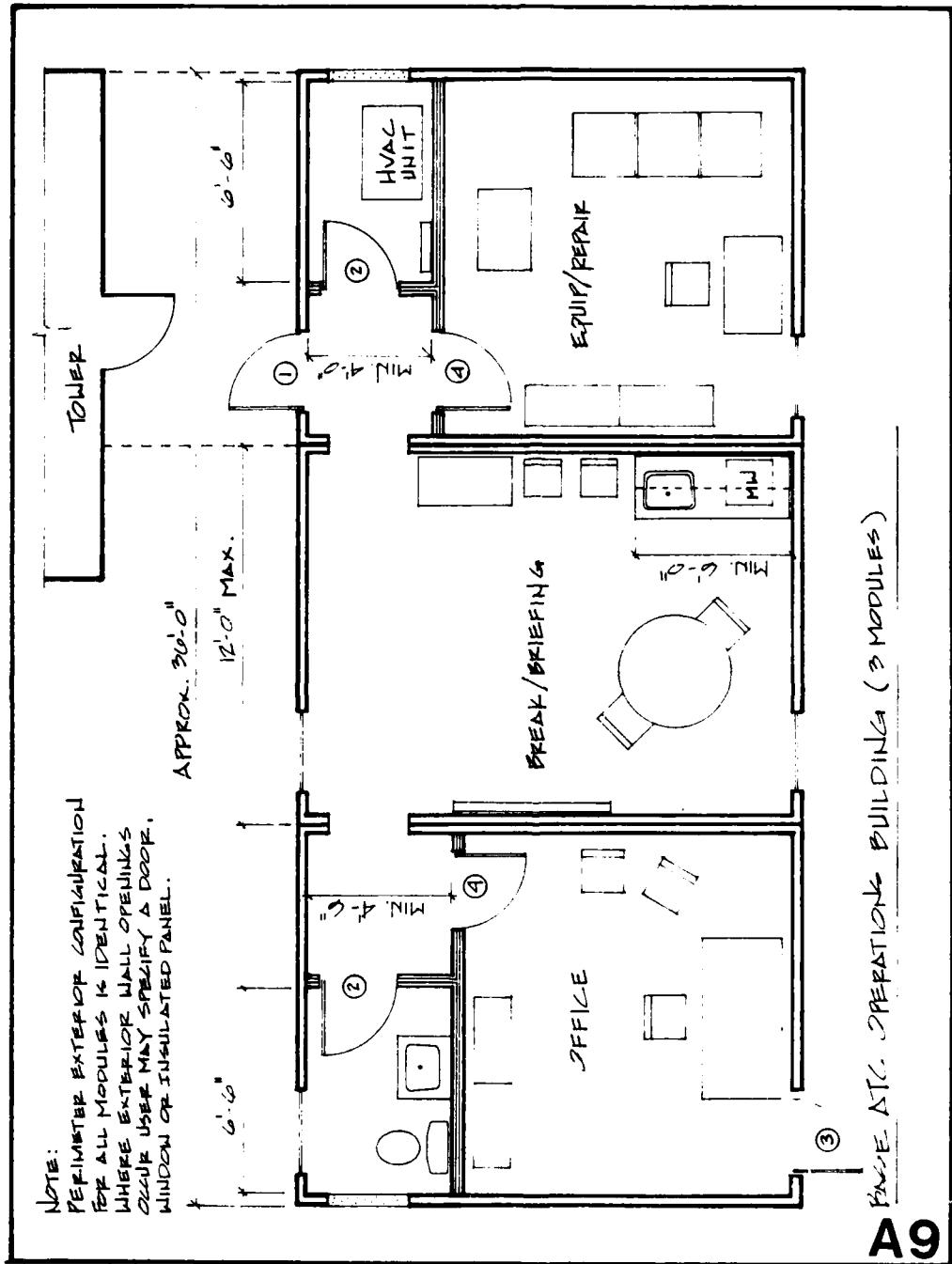
37



A7

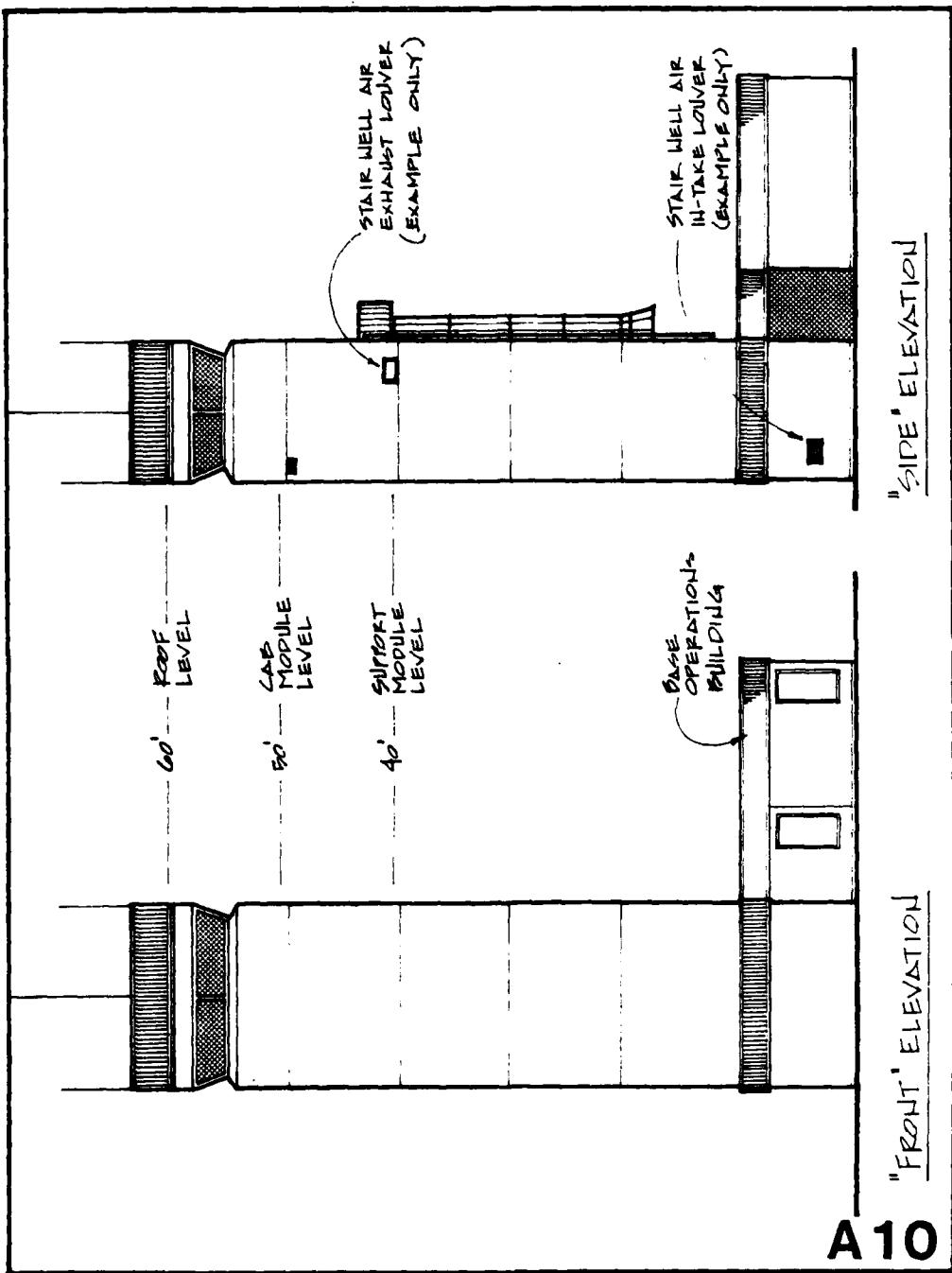


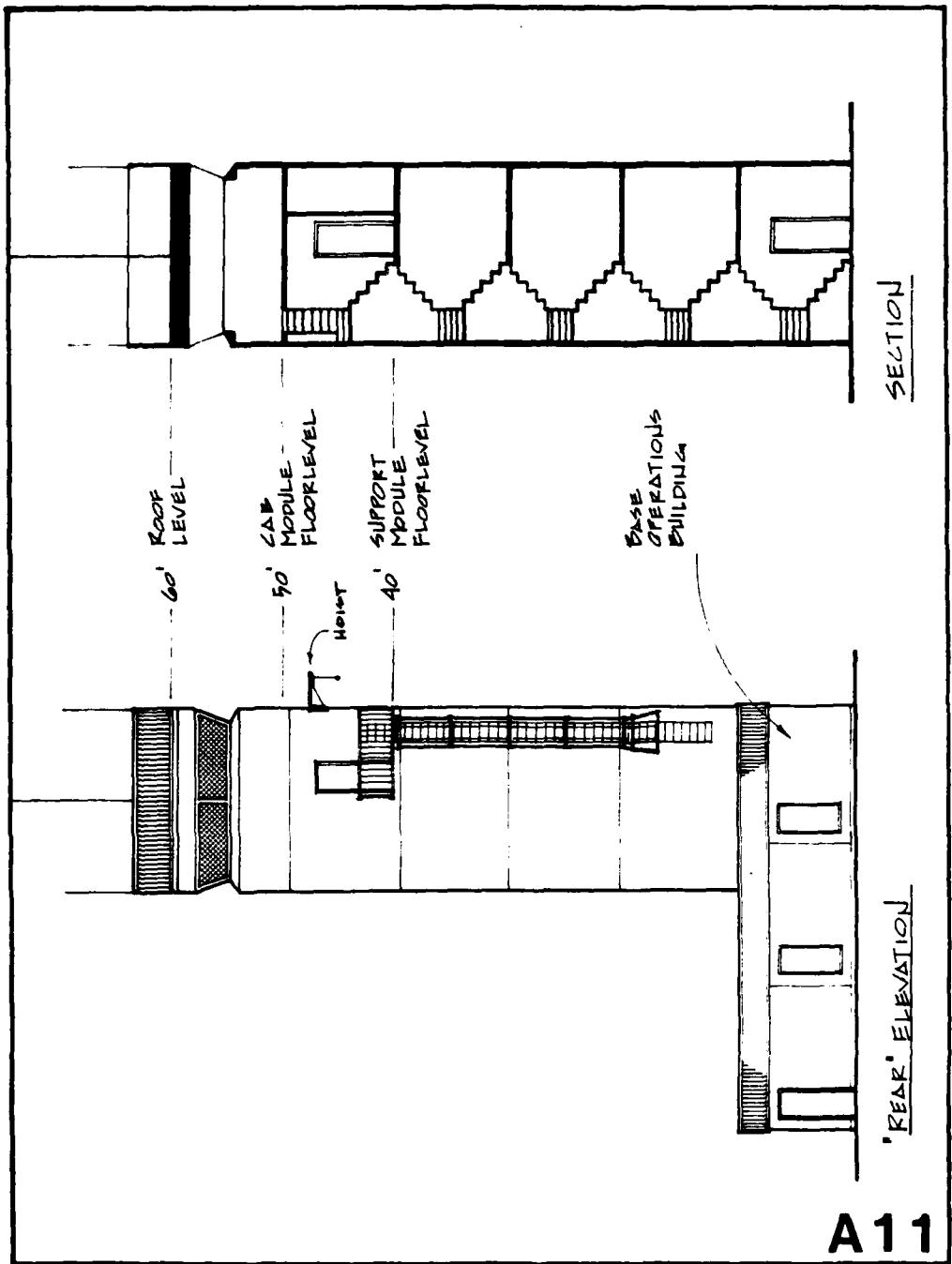
A8



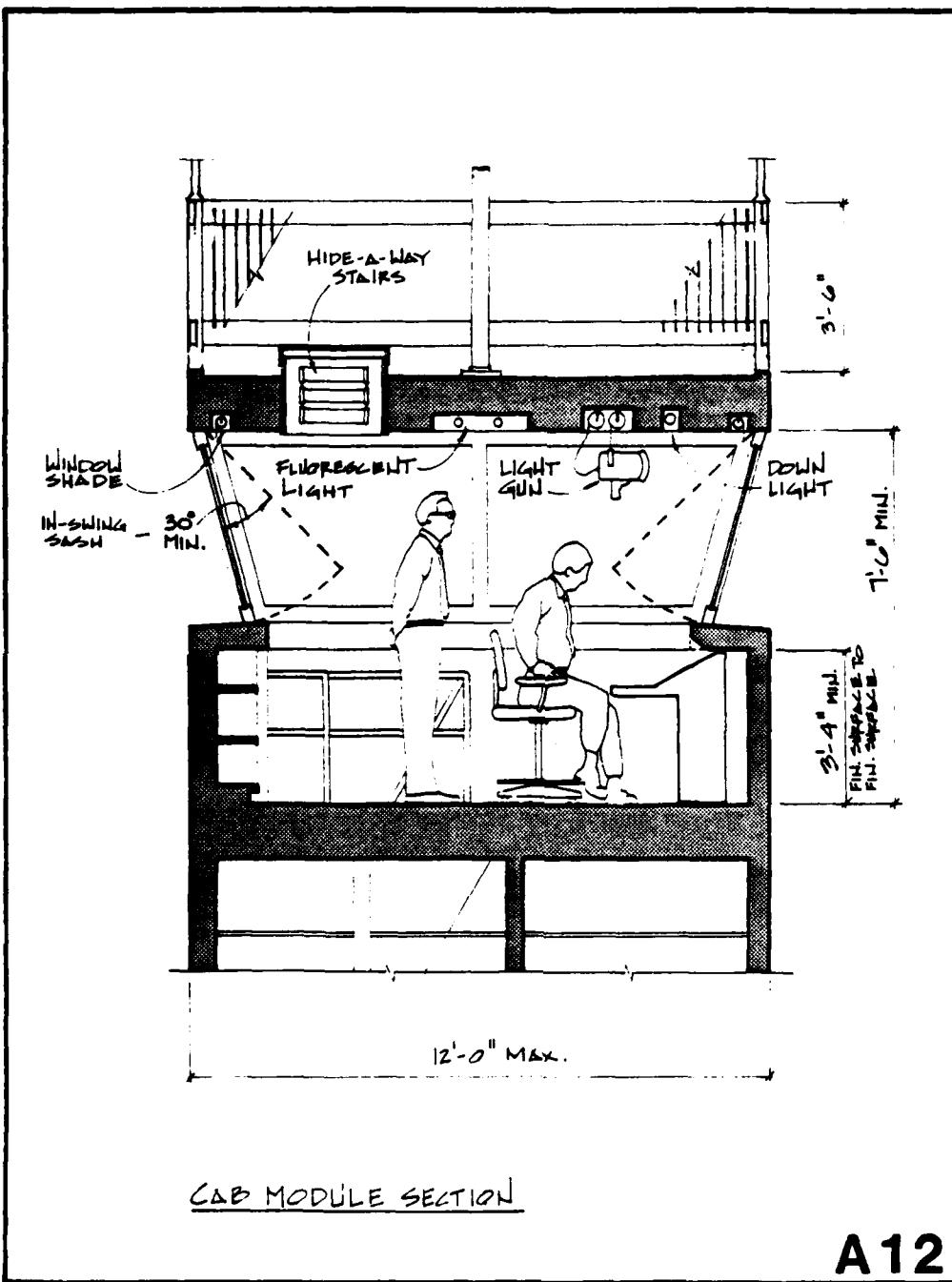
A9

BASE ATC OPERATIONS BUILDING (3 MODULES)

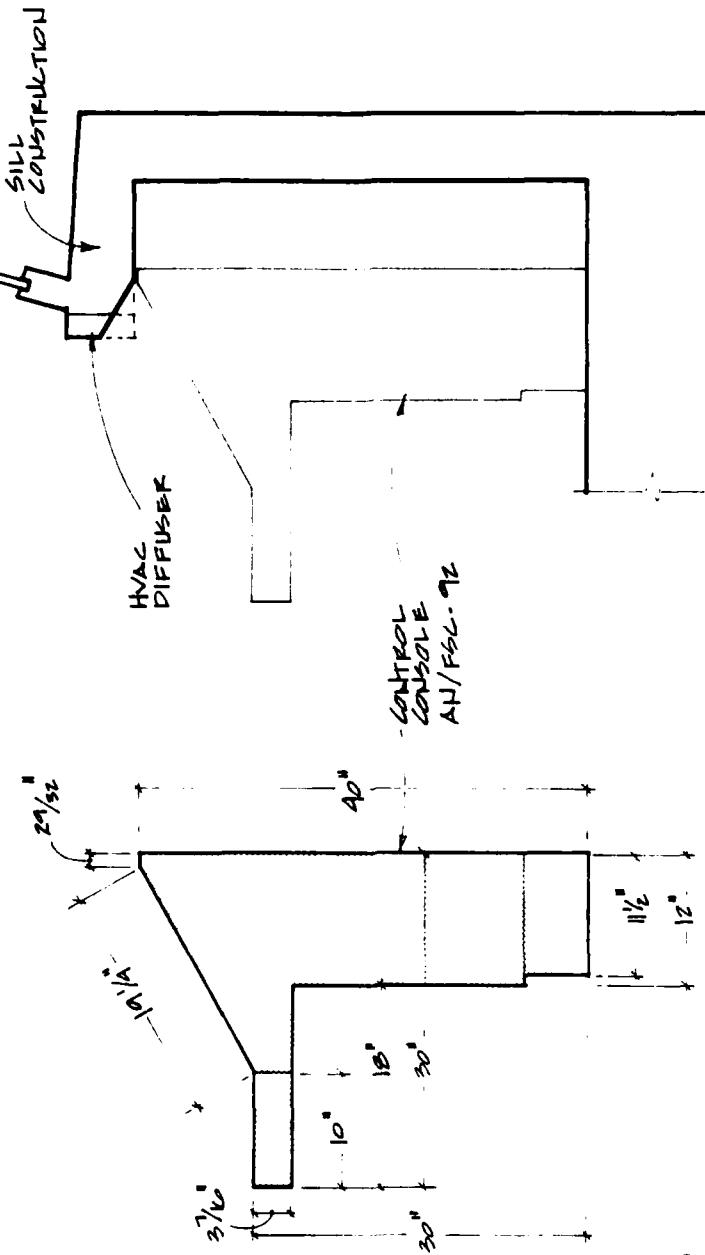


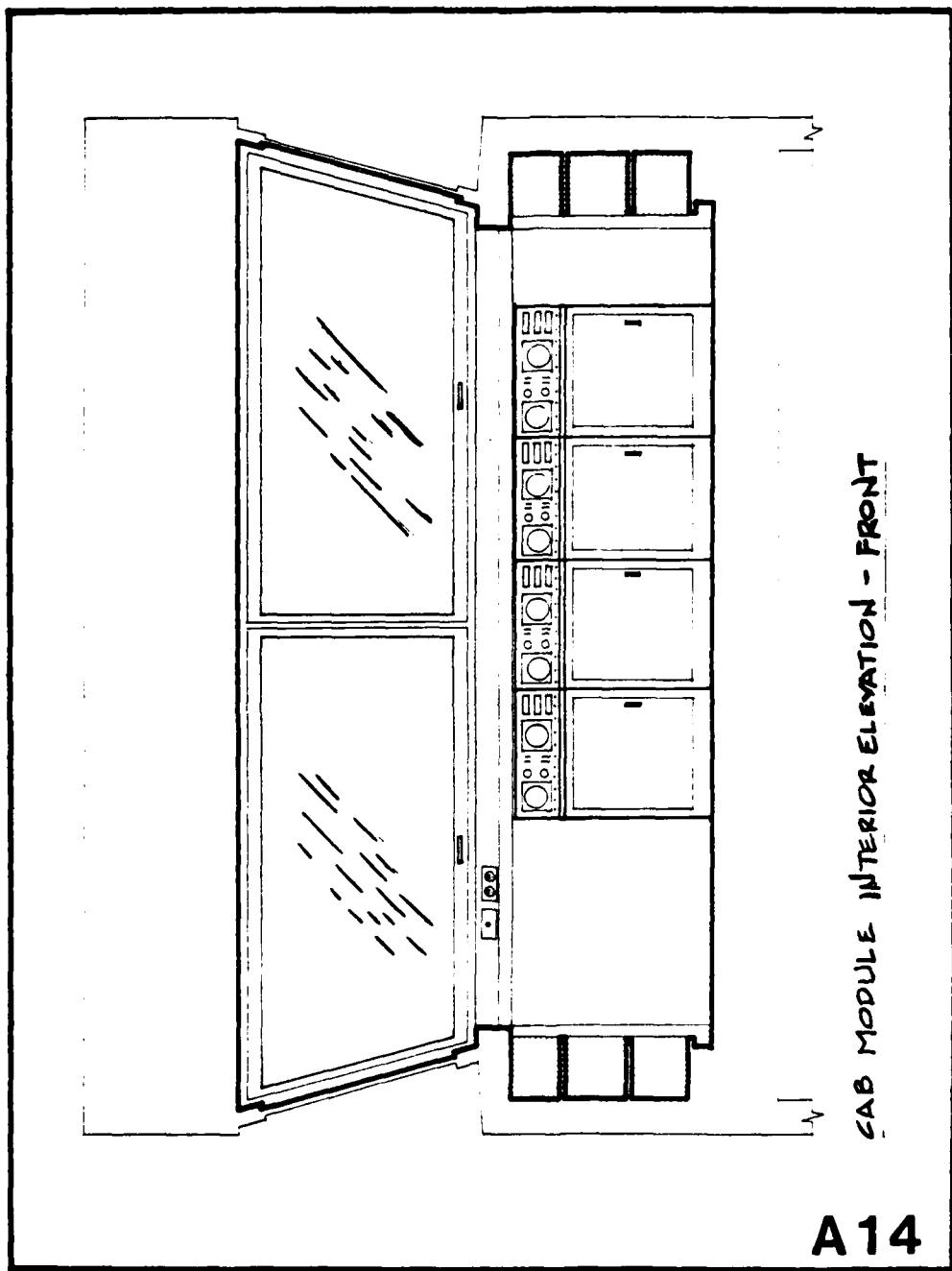


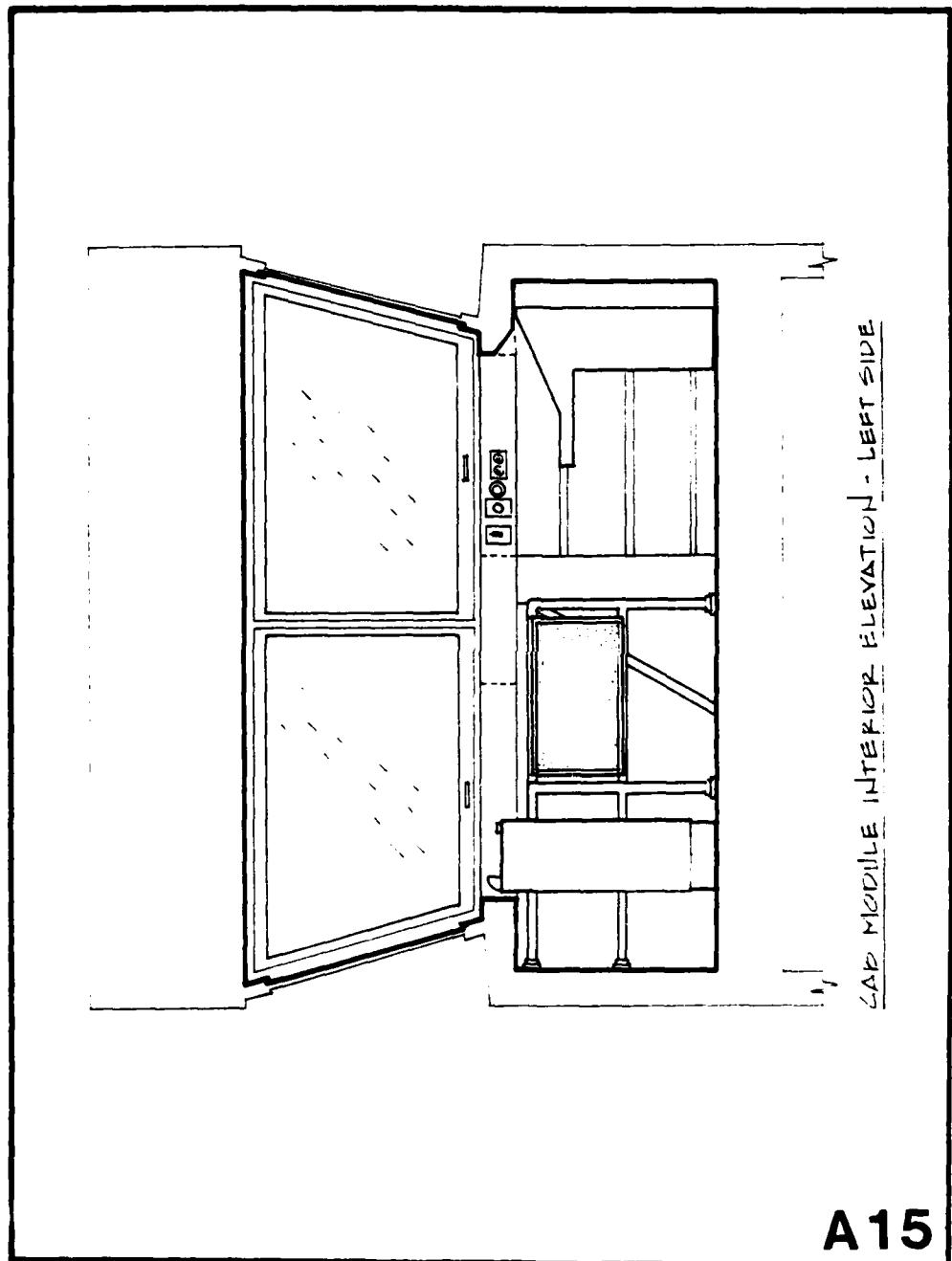
A11



PROPOSED SILL DESIGN & CONSTRUCTION
TO CONSIDER VISIBILITY OF CONTROL
CONSOLE INSTRUMENTATION -
LEVEL UNDERSIDE OF SILL IF POSSIBLE

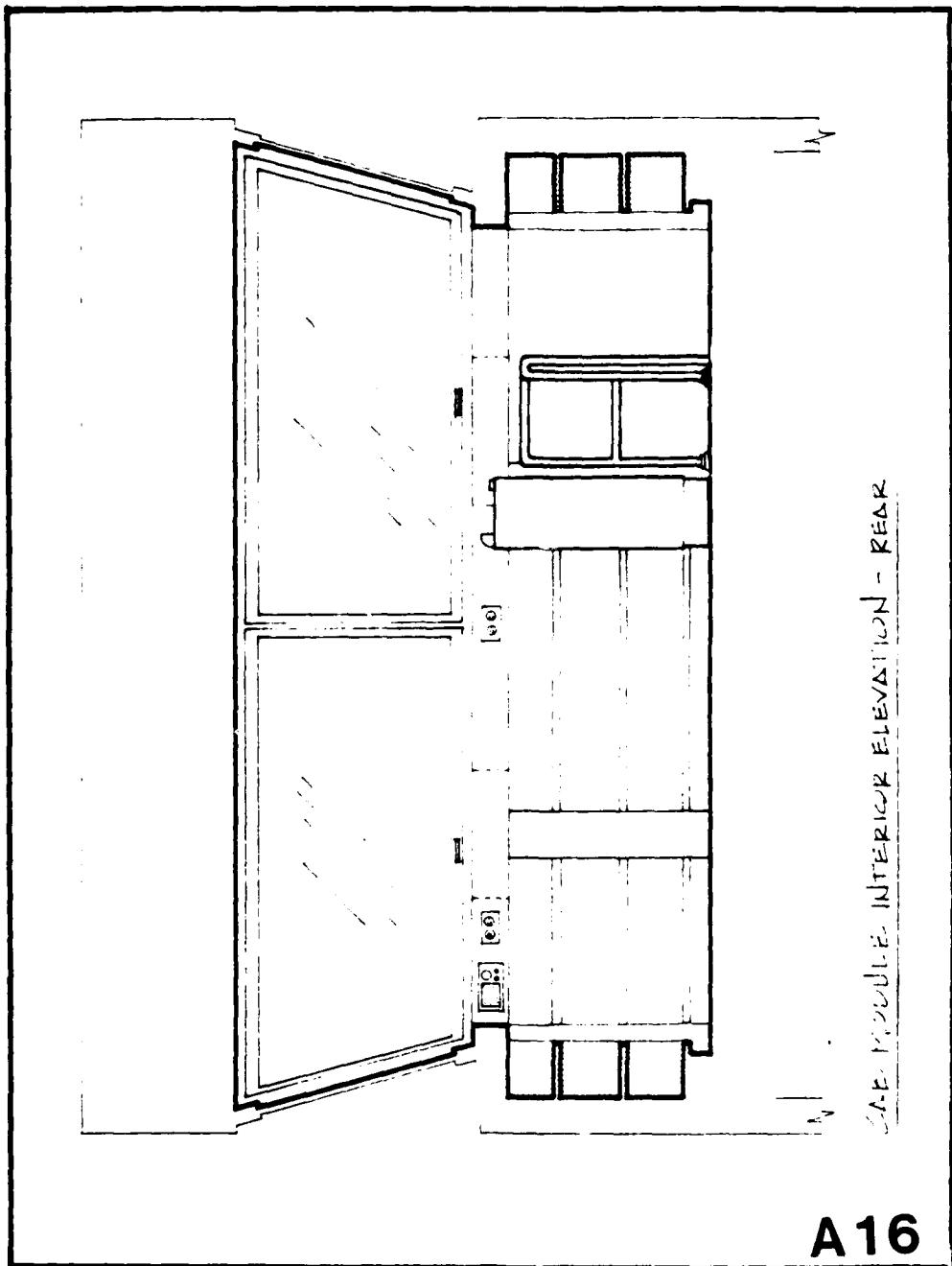






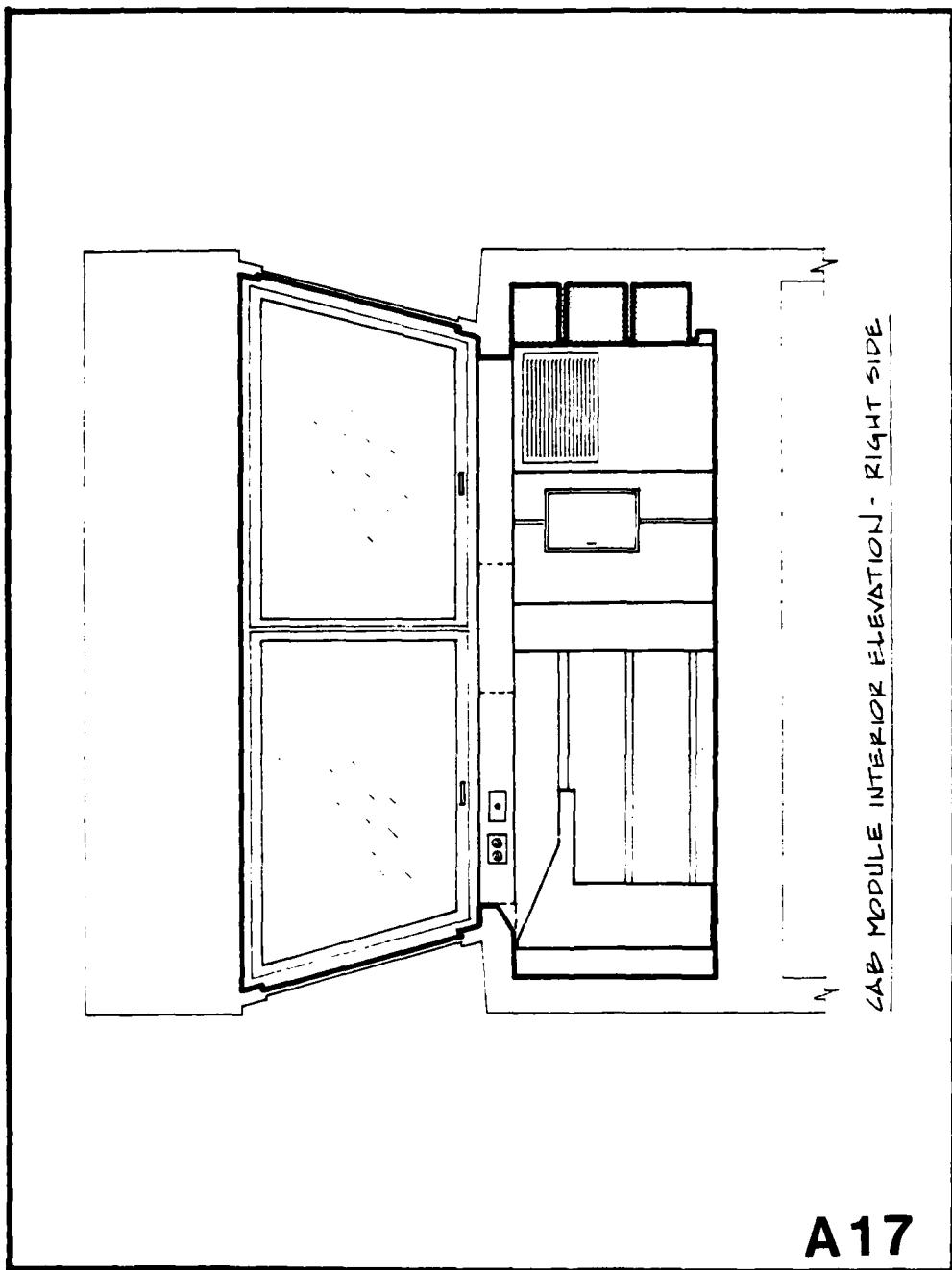
CAB MOBILE INTERIOR ELEVATION - LEFT SIDE

A15



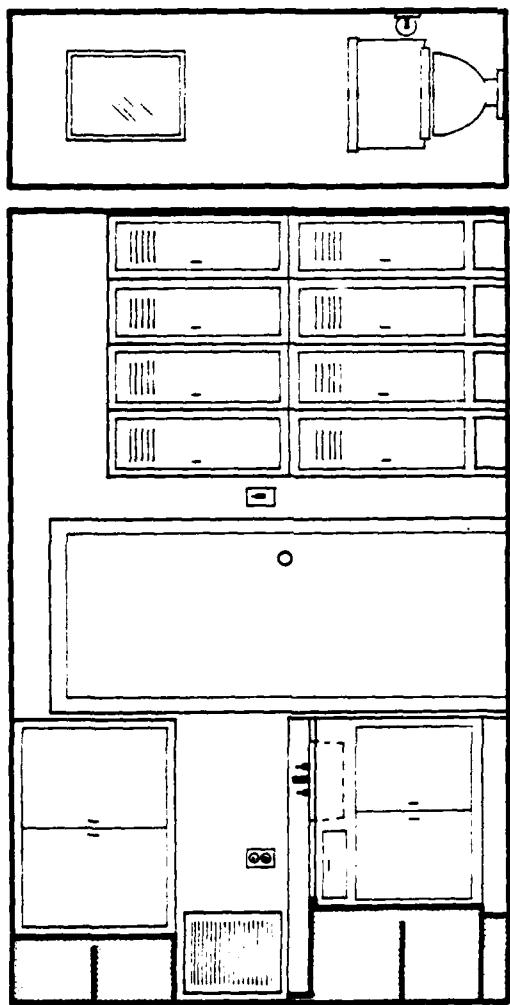
A16

ST. E. REAR INTERIOR ELEVATION - REAR



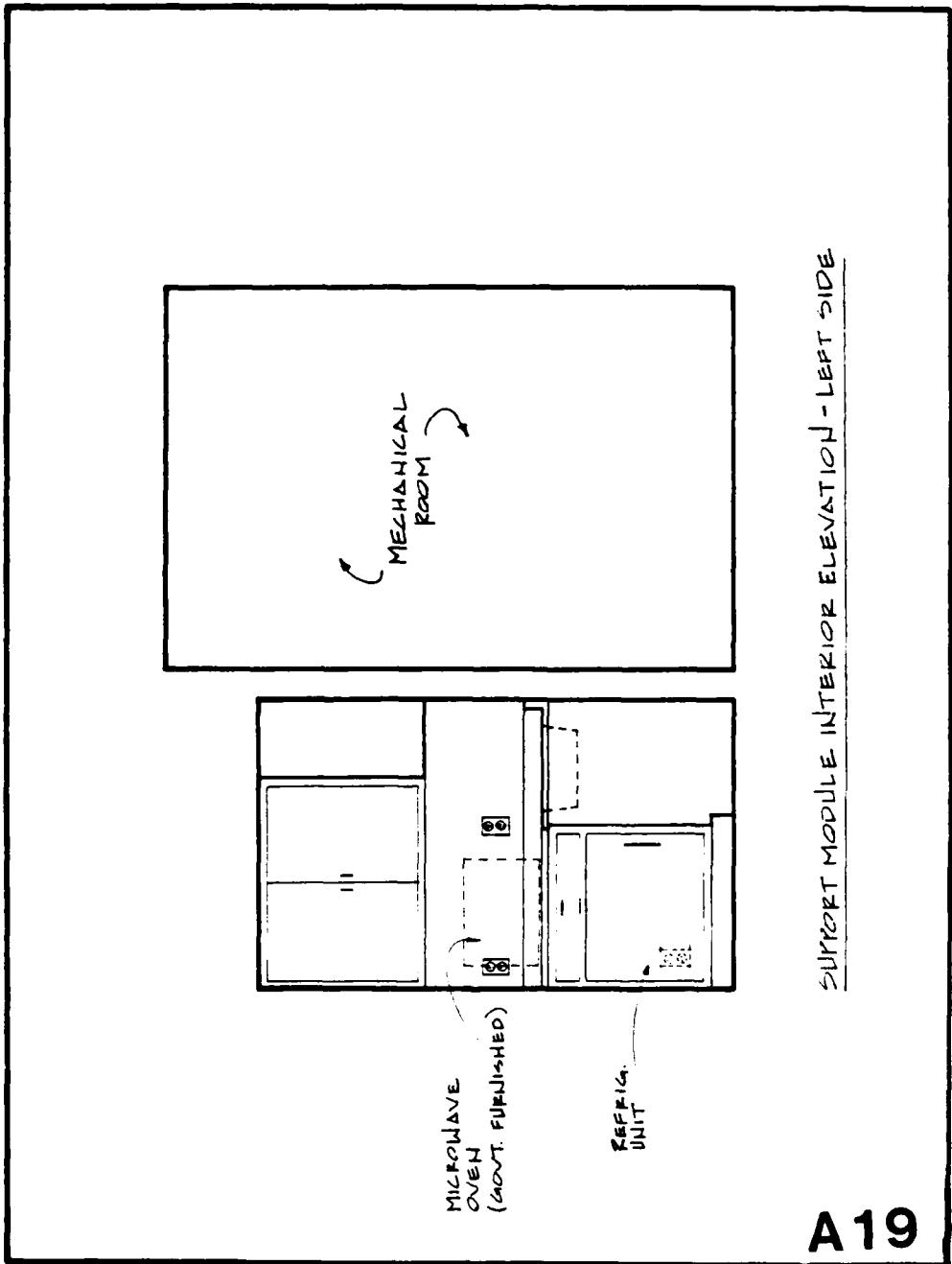
A17

NOTE: PREFABRICATED
KITCHENETTE UNIT MAY
BE USED.

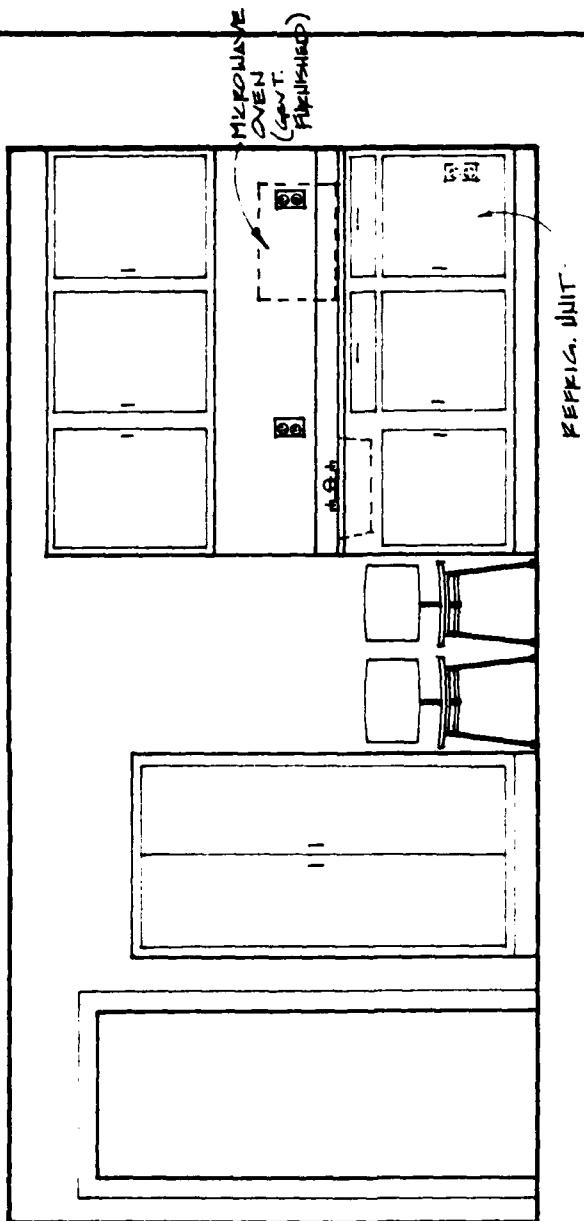


SUPPORT MODULE INTERIOR ELEVATION - FRONT

A18



NOTE:
PREFABRICATED KITCHENETTE
UNIT MAY BE USED.



BASE AT&T OPERATIONS BUILDING - KITCHETTE

A20

FINISH SCHEDULE

	<u>Floor</u>	<u>Bases</u>	<u>Walls</u>	<u>Ceiling</u>	<u>Trim</u>	<u>Ceiling Height</u>
Cab.	Carpet	None	Carpet	Acoustic Tile	Paint	7'-6"
Support Module	V.A.T./V.S.	Vinyl	Metal Panel	Suspended Acoustic Paint		7'-6" Minimum
Kitchenette	V.A.T./V.S.	Vinyl	Metal Panel	Unfinished	Paint	9'
Mechanical						
Stair Module	V.A.T./V.S.	Vinyl	Metal Panel	Unfinished	Paint	9'
Middle	Sealed	Vinyl	Metal Panel	Unfinished	Paint	9'
Ground						
Conc.						
Base Module	V.A.T./V.S.	Vinyl	Metal Panel	Suspended Acoustic Paint		9'
Mechanical	V.A.T./V.S.	Vinyl	Metal Panel	Suspended Acoustic Paint		7'-6" Minimum
others						

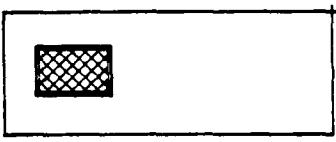
V.S. = Vinyl Sheet

A21

DOOR SCHEDULE

No.	Type	W	Hr.	T.	Construction	Threshold	Hardware
1	B	2'-6"	6'-8"	1 3/4"	Insulated	Metal or Door Bottom Sweep	Panic Bar Closer Intercom Control
6	A	2'-6"	6'-8"	1 3/4"	Hollow Core	None	Weatherstrip Lockset without lock
3	A	2'-6"	6'-8"	1 3/4"	Insulated	Metal or Door Bottom Sweep	Panic Bar Closer
4	A	2'-6"	6'-8"	1 3/4"	Hollow Core	None	Weatherstrip Lockset with dead bolt
5	B	2'-6"	6'-8"	1 3/4"	Insulated	None	Lockset without lock Weatherstrip
6	B	2'-6"	6'-8"	1 3/4"	Insulated	Metal or Door Bottom Sweep	Panic Bar Closer

*All doors are painted metal in painted metal door frames.



Type A



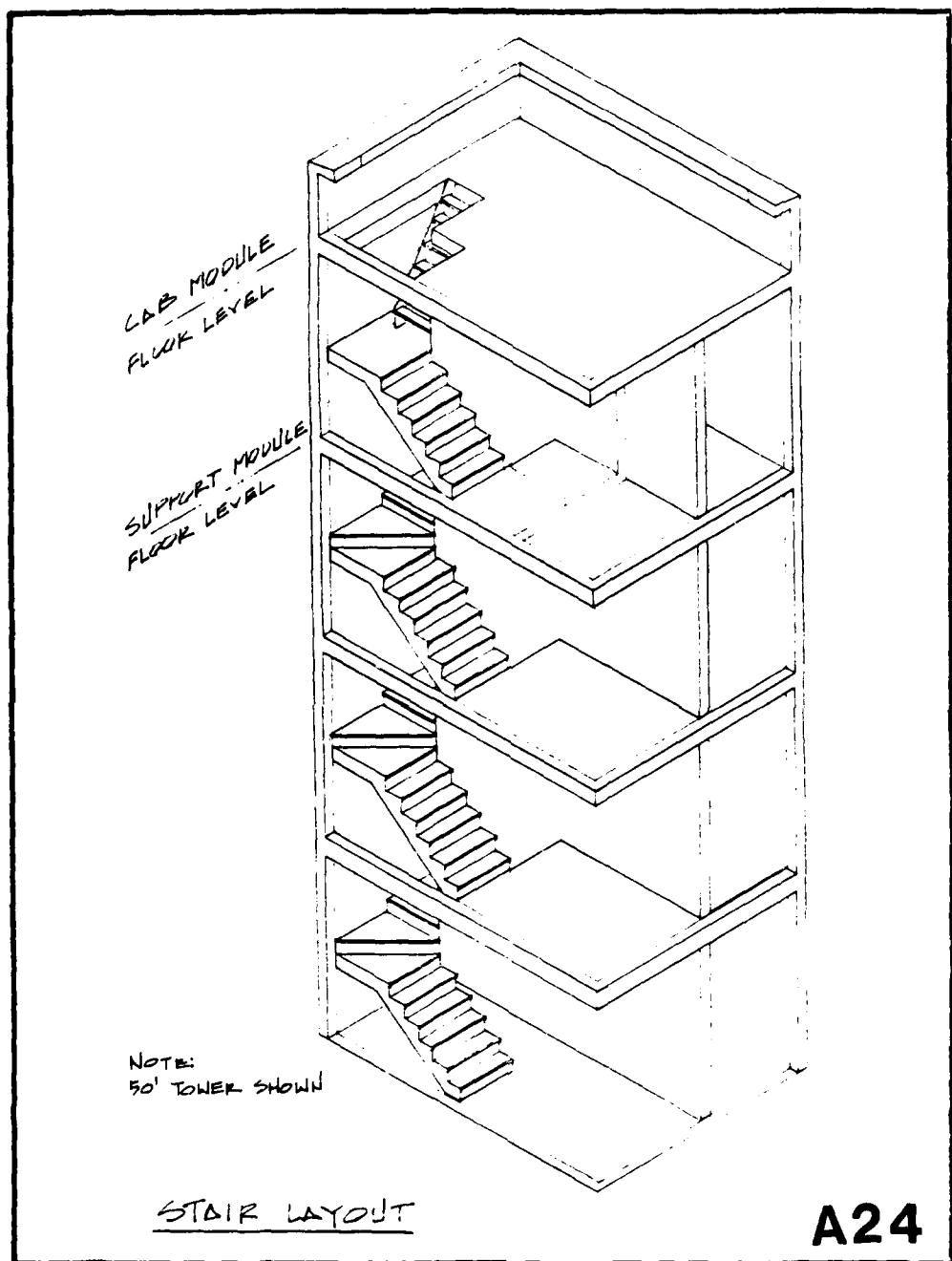
Type B

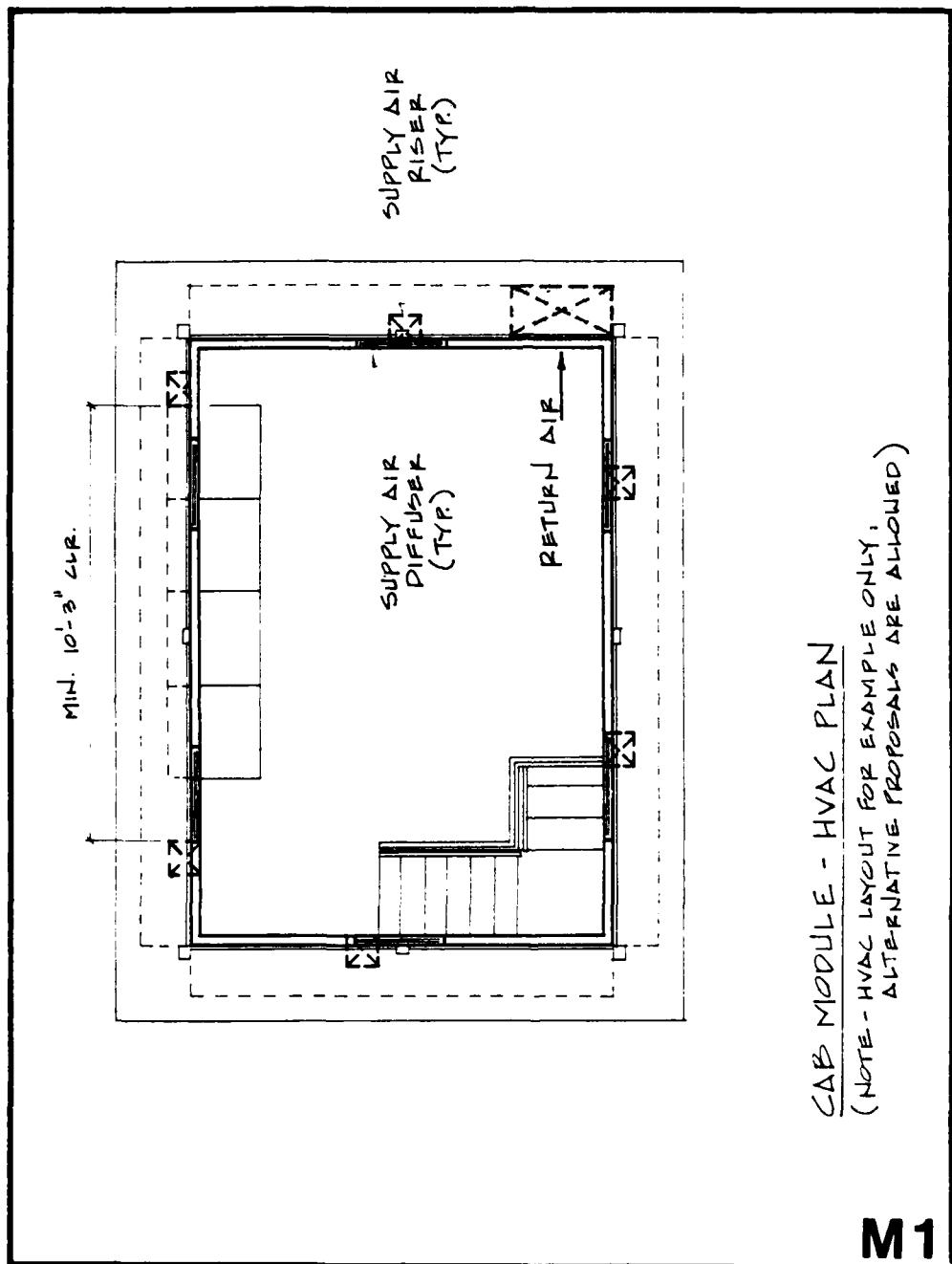
A22

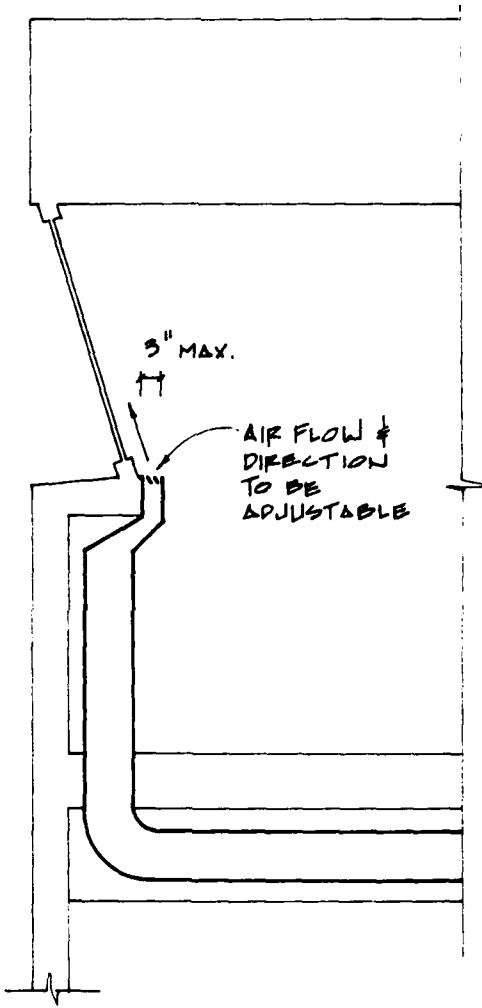
GENERAL EQUIPMENT & ACCESSORY SCHEDULE

<u>Equipment</u>	<u>Remarks</u>
Roof	
Cab	Lightning Rod Chalkboard/tack board Window shades (all 4 sides) Electric water cooler
Support	Kitchenette unit w/sink, base cabinets wall cabinets and under-counter refrigerator Paper towel holder Smoke alarm Toilet paper holder Mirror (14" x 20" min.)
Balcony	300 lb. Capacity Hoist To be mounted on a swing-arm w/270° swing capacity, hoist "hook" to be able to clear top guard rail by 36" min.
Stairwell	Smoke alarm at every landing
Base ATC Building:	
Equip./Repair Module	
Office Module	
Break/Briefing Module	Kitchenette unit (24" x 60" min.) w/ sink, base cabinets, wall cabinets and under-sink refrigerator Paper towel holder Chalkboard/tack board (48" x 72") Smoke alarm

A23

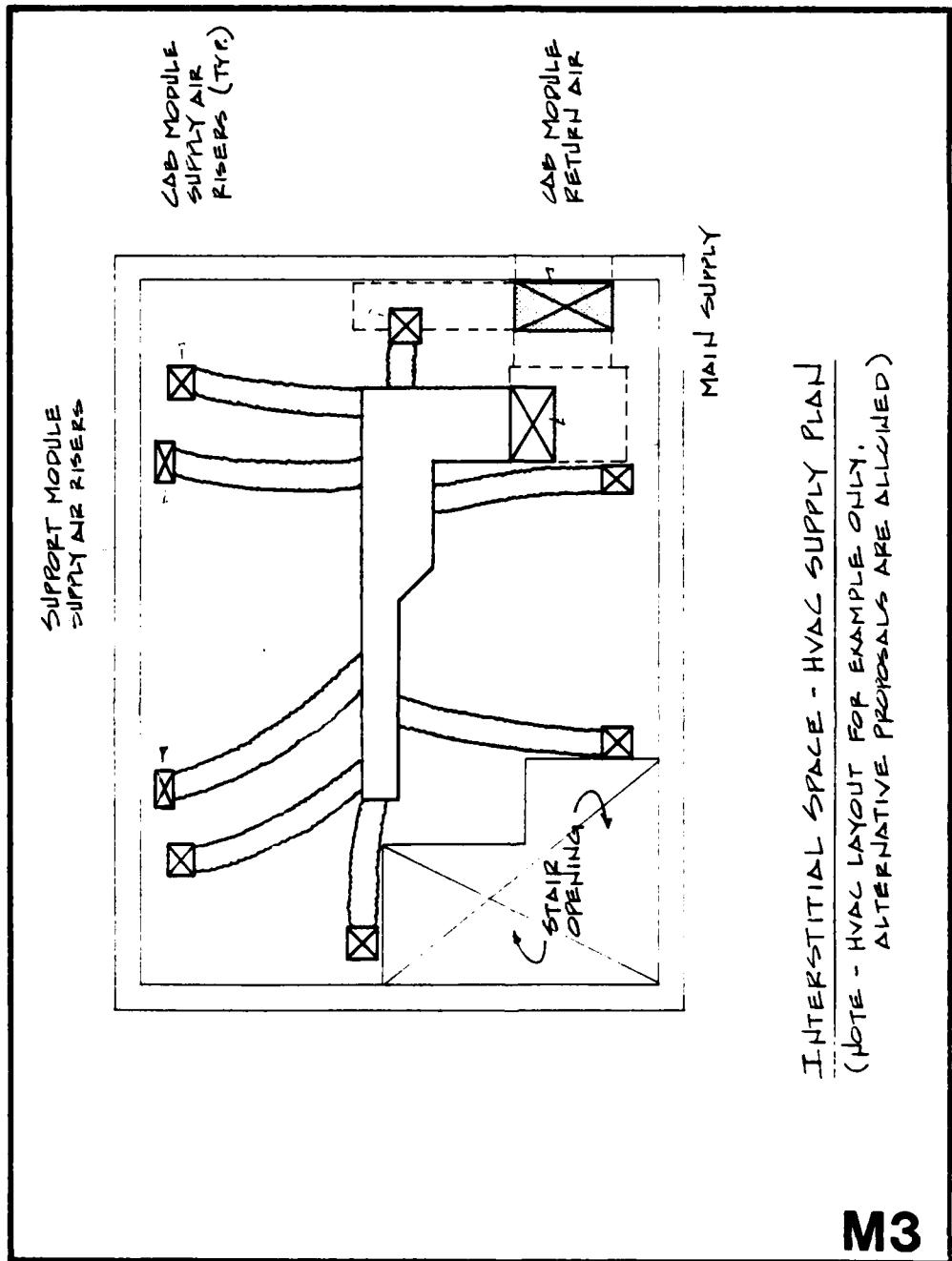


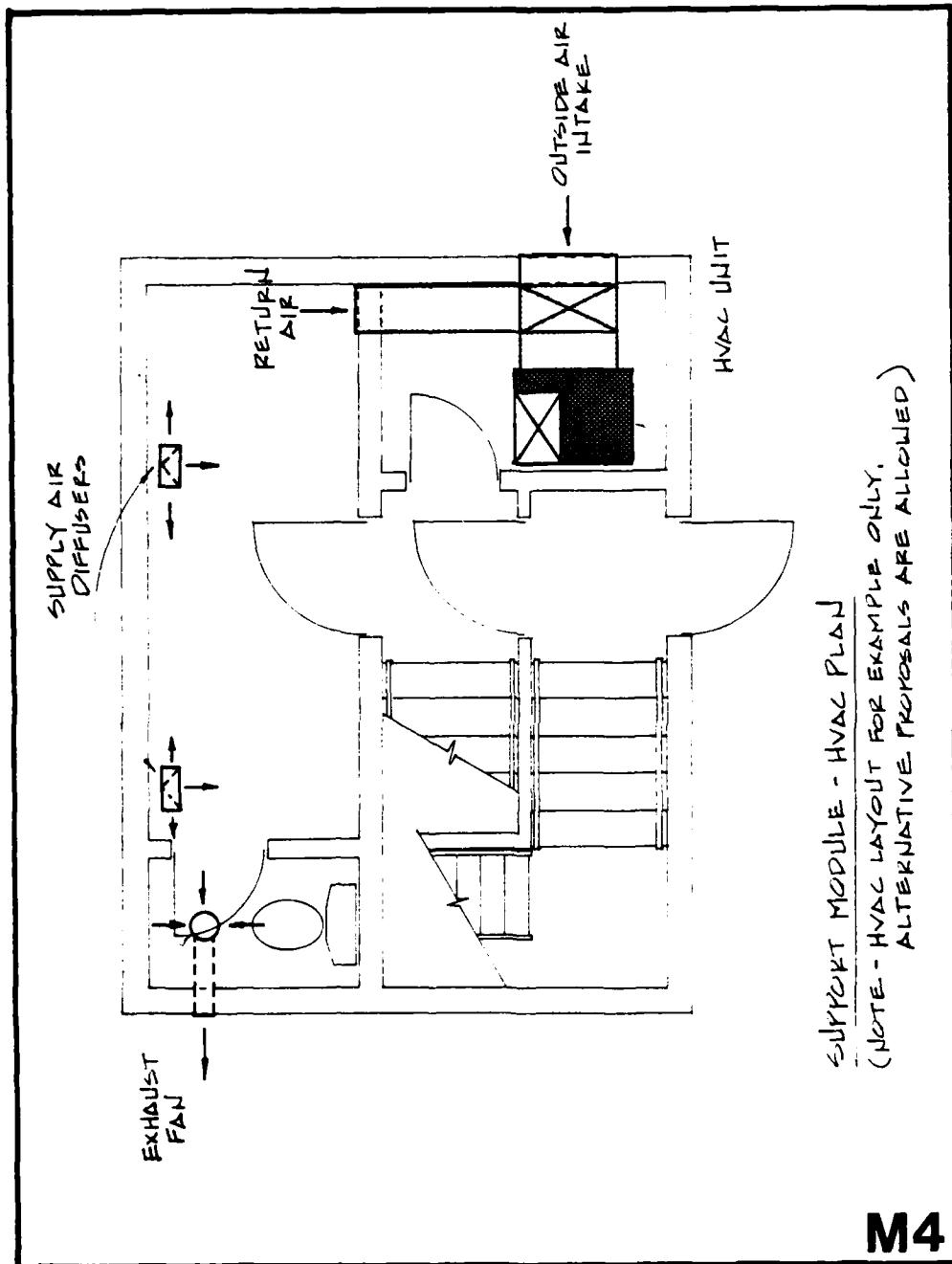


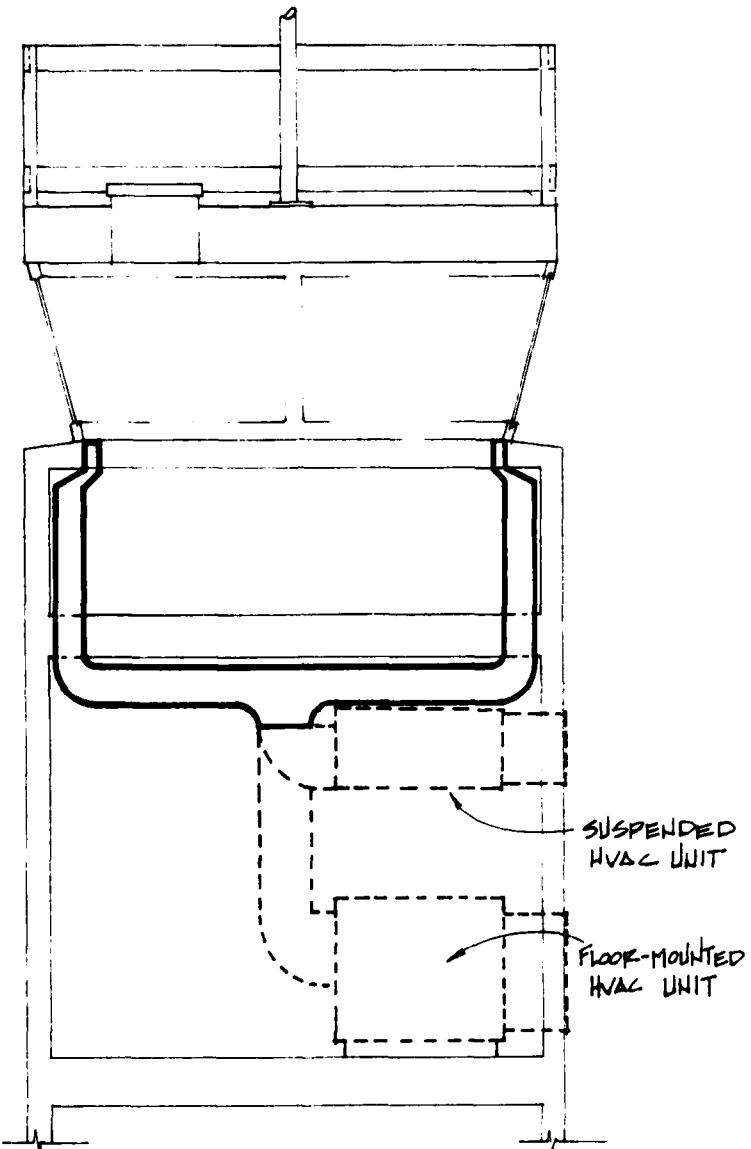


CAB MODULE SECTION - HVAC SUPPLY & DIFFUSER

M2

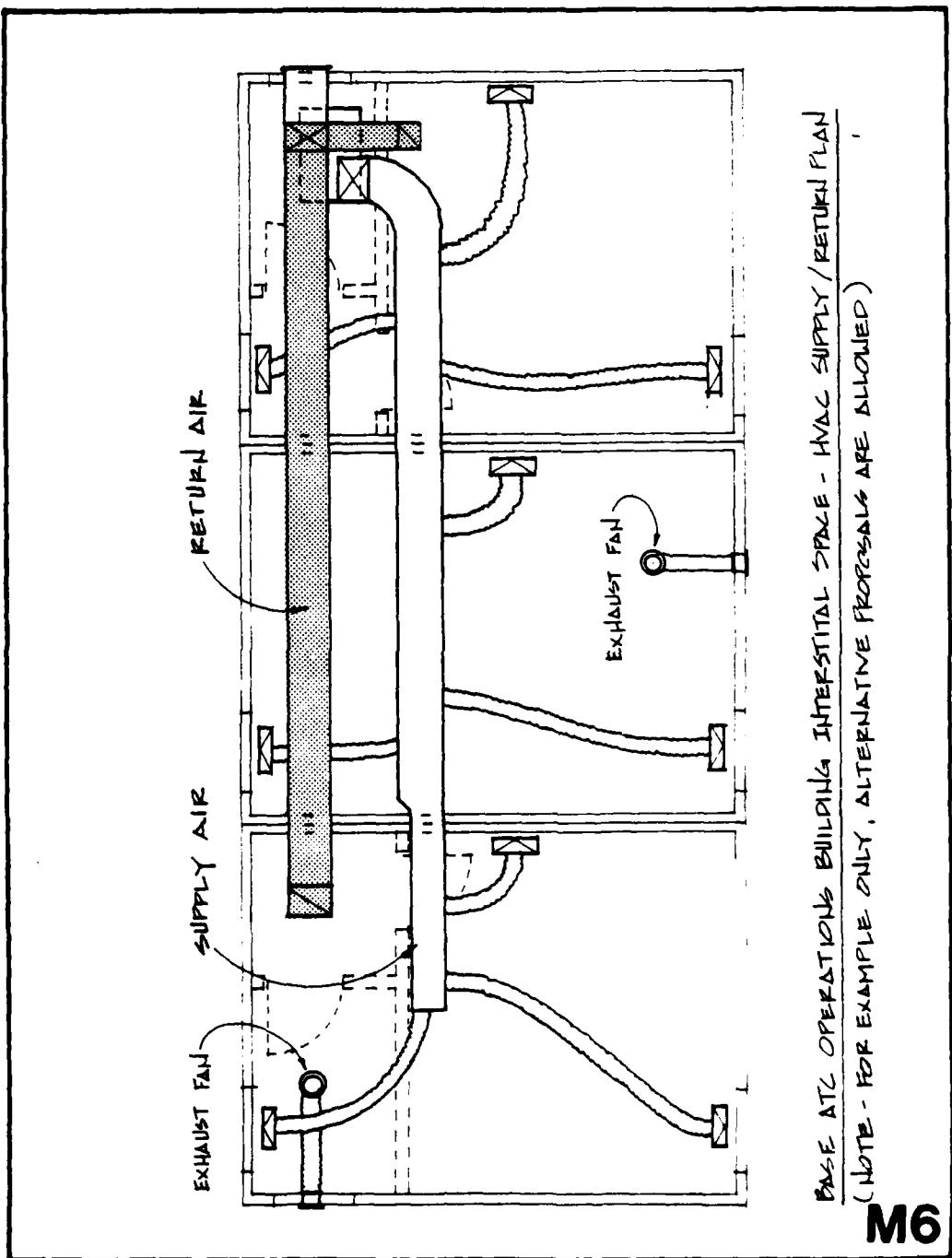


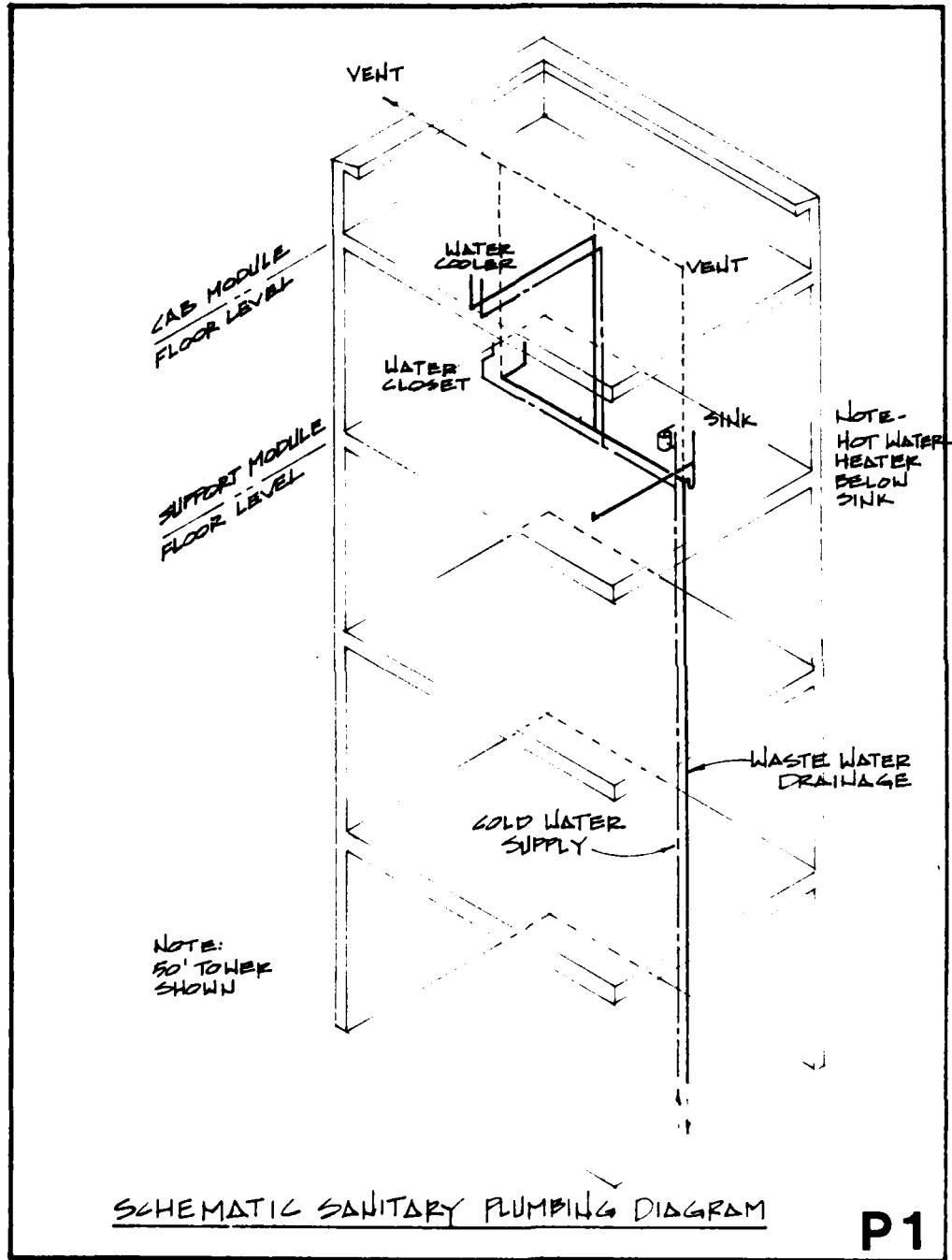


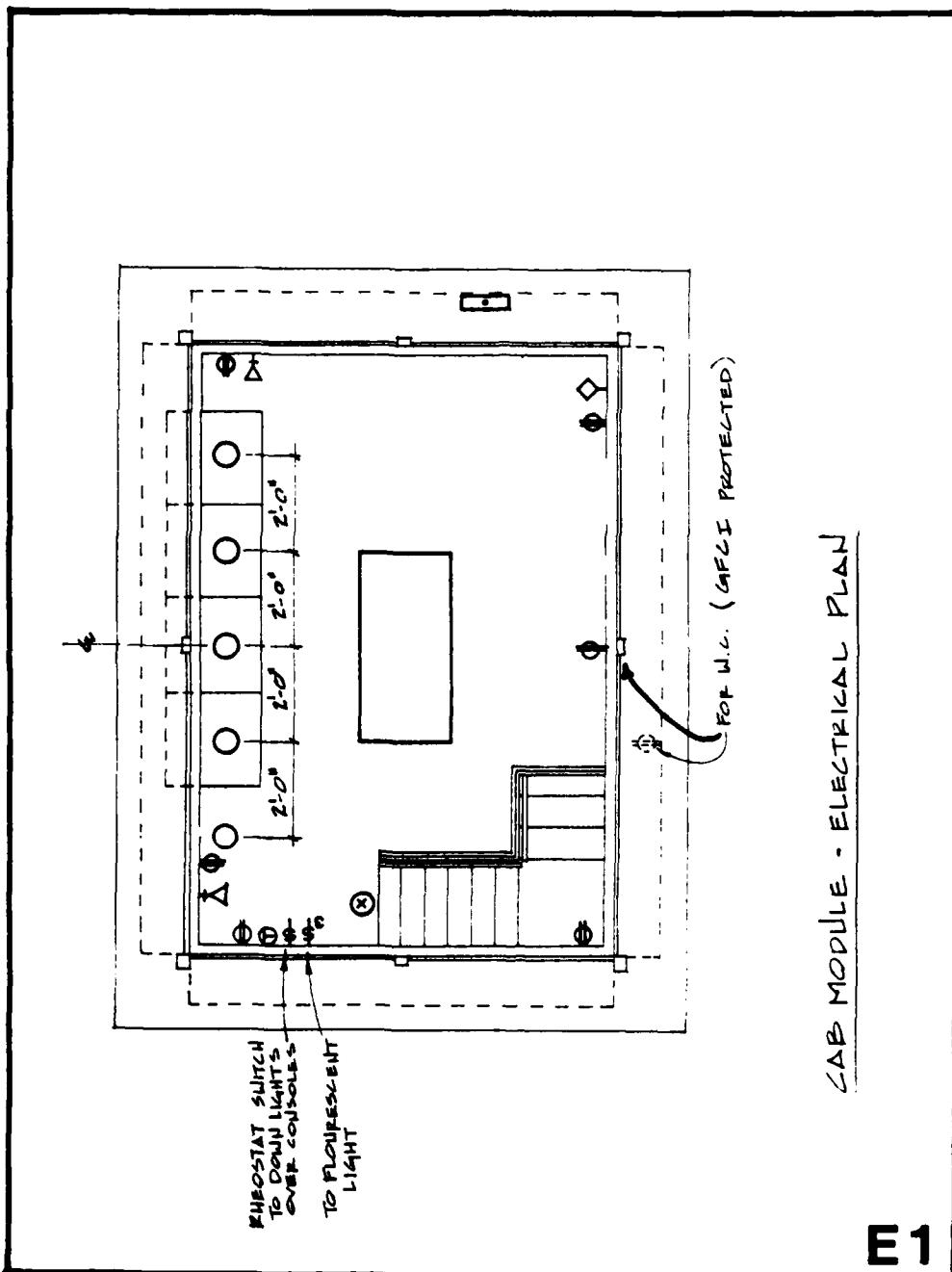


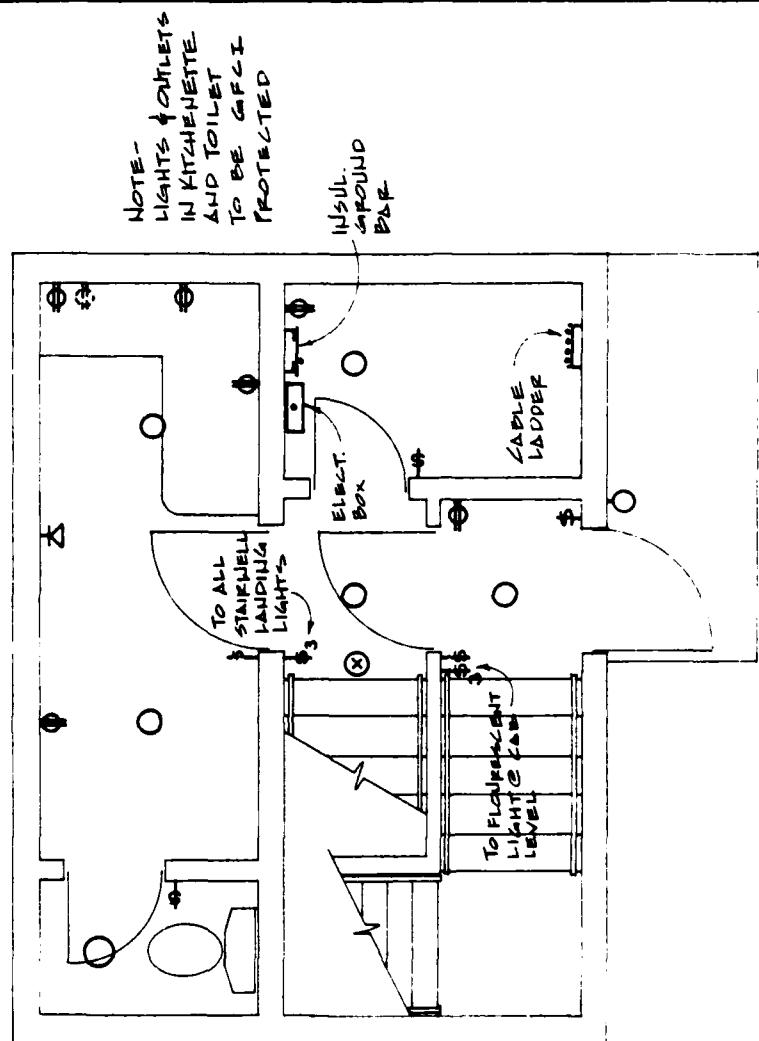
ALTERNATIVE HVAC UNIT POSITIONING

M5



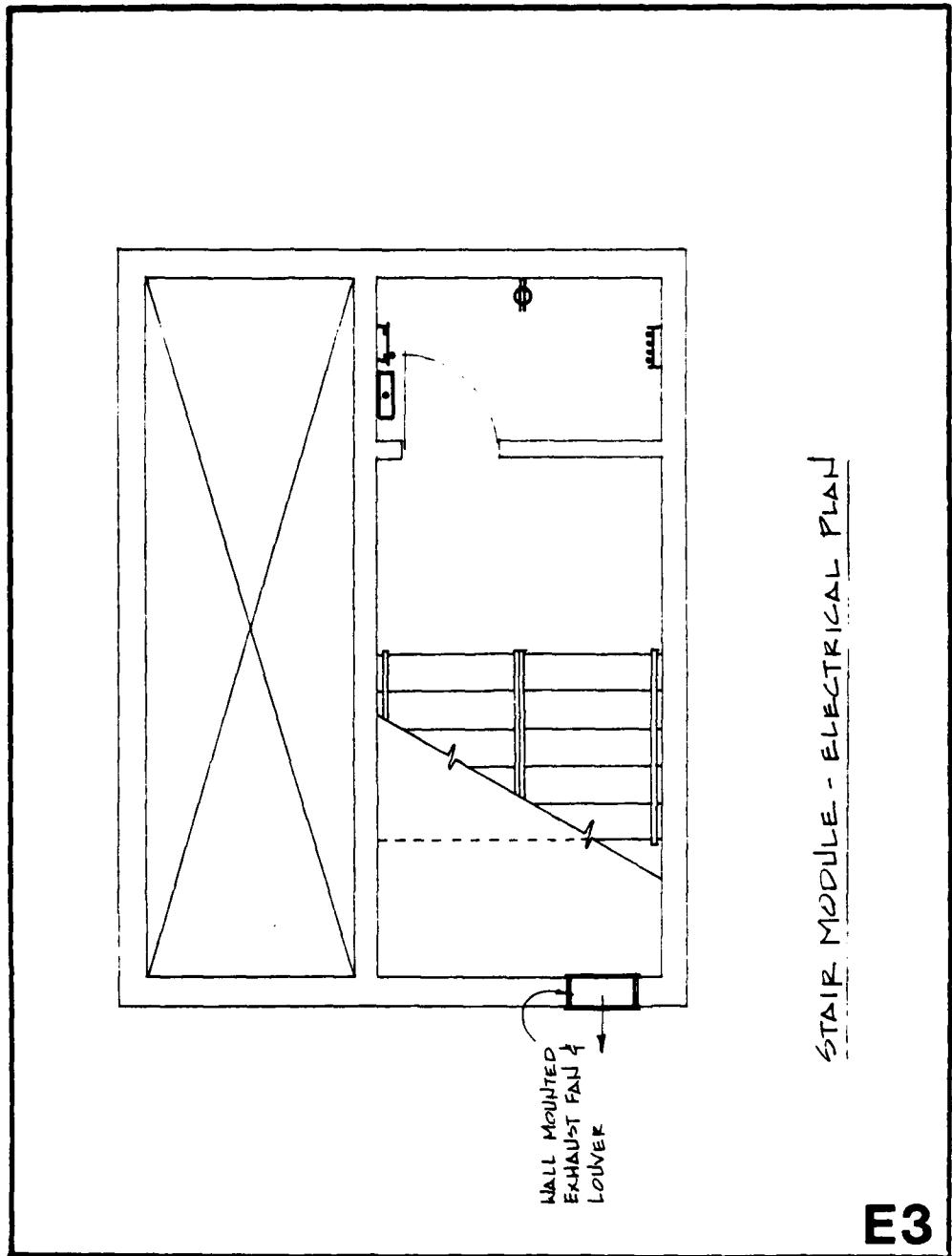






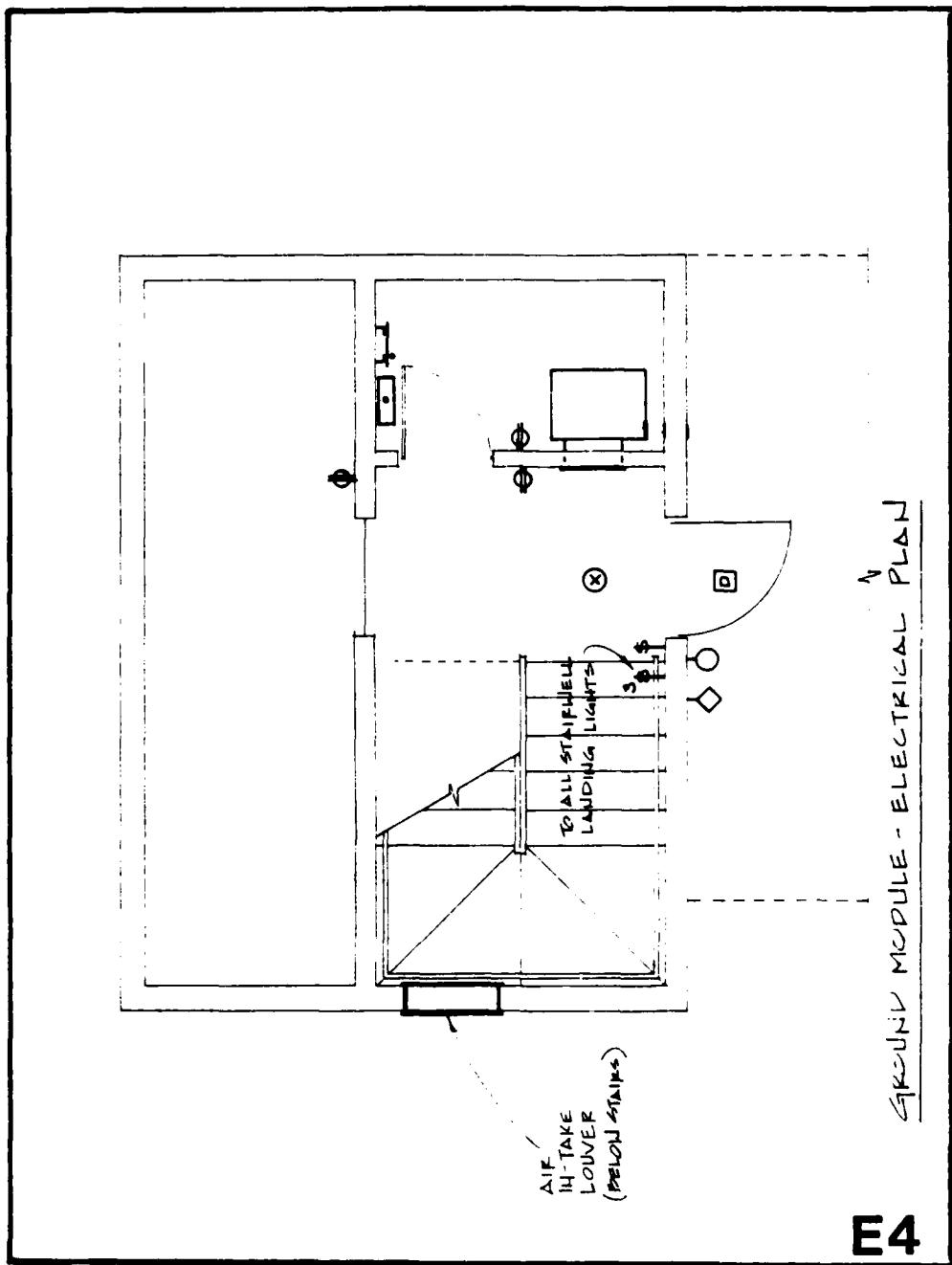
SUPPORT MODULE - ELECTRICAL PLAN

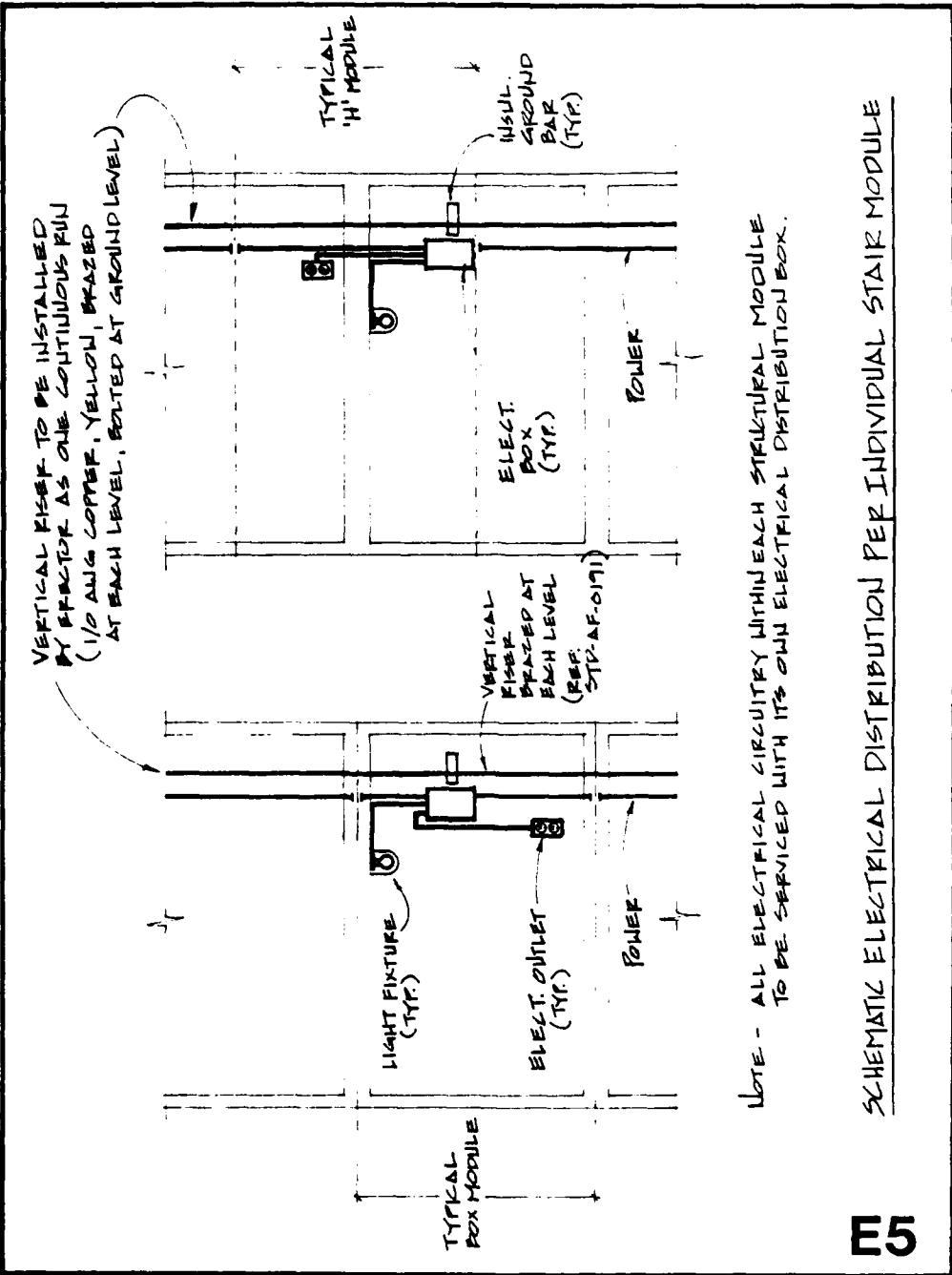
E2

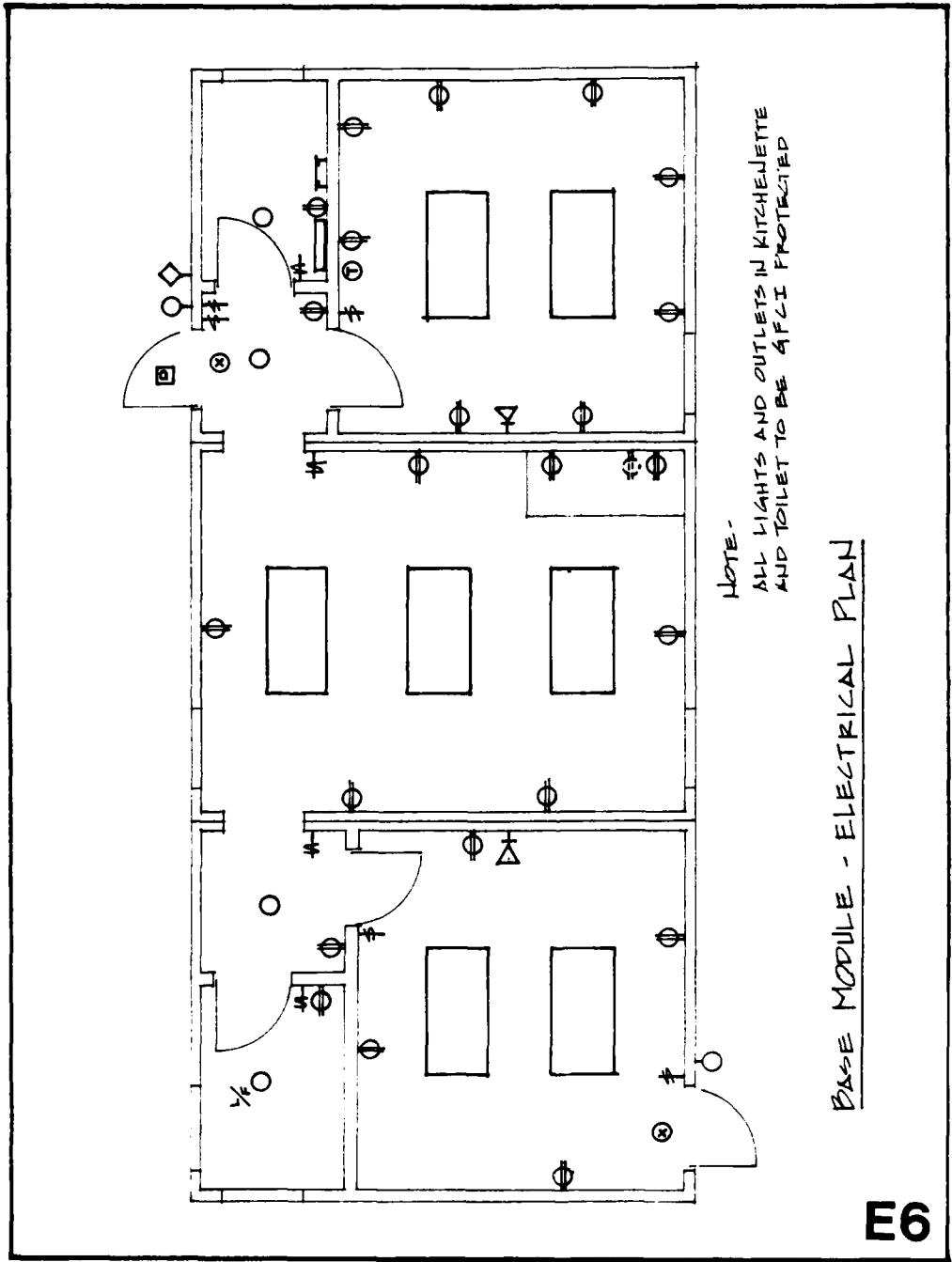


STAIR MODULE - ELECTRICAL PLAN

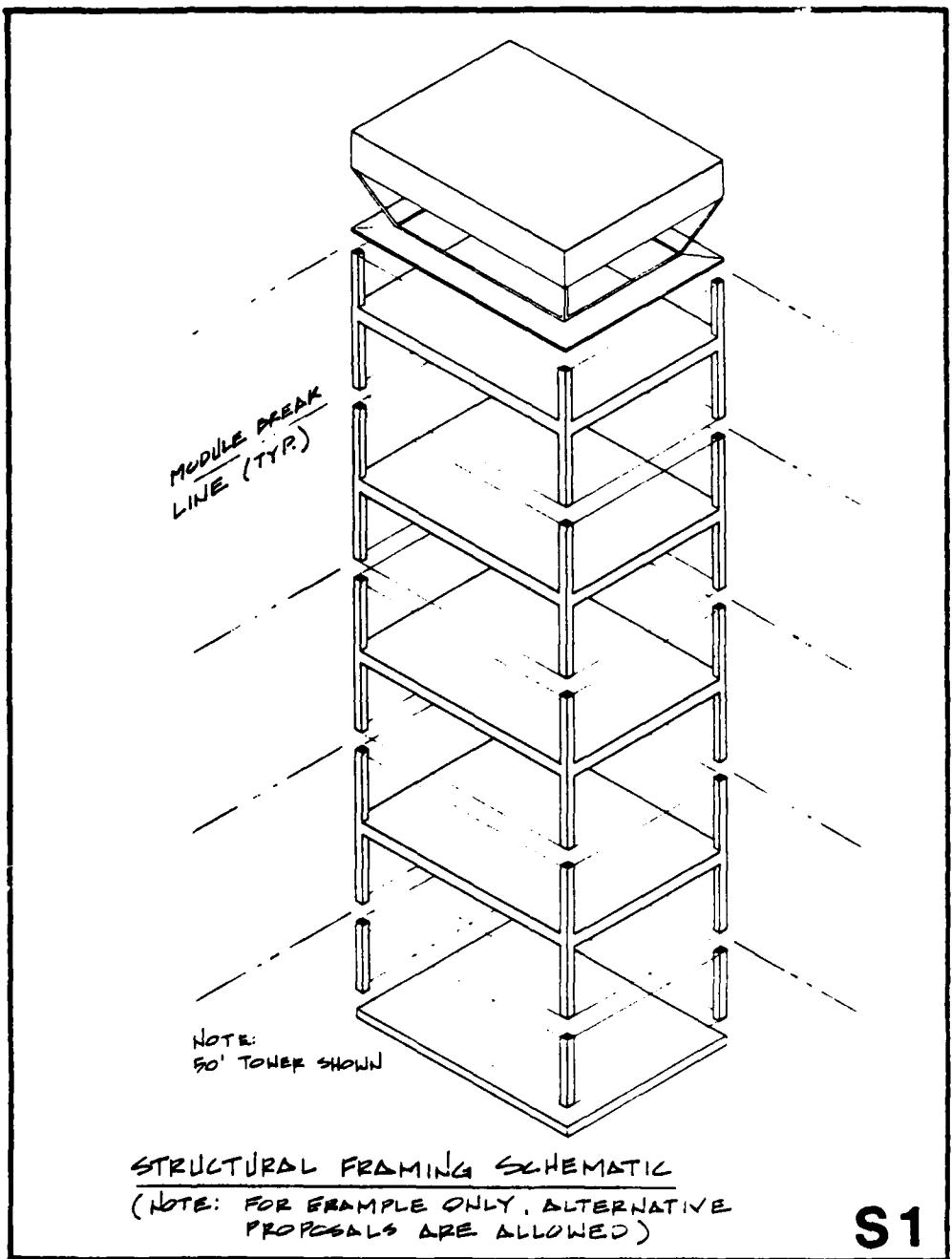
E3

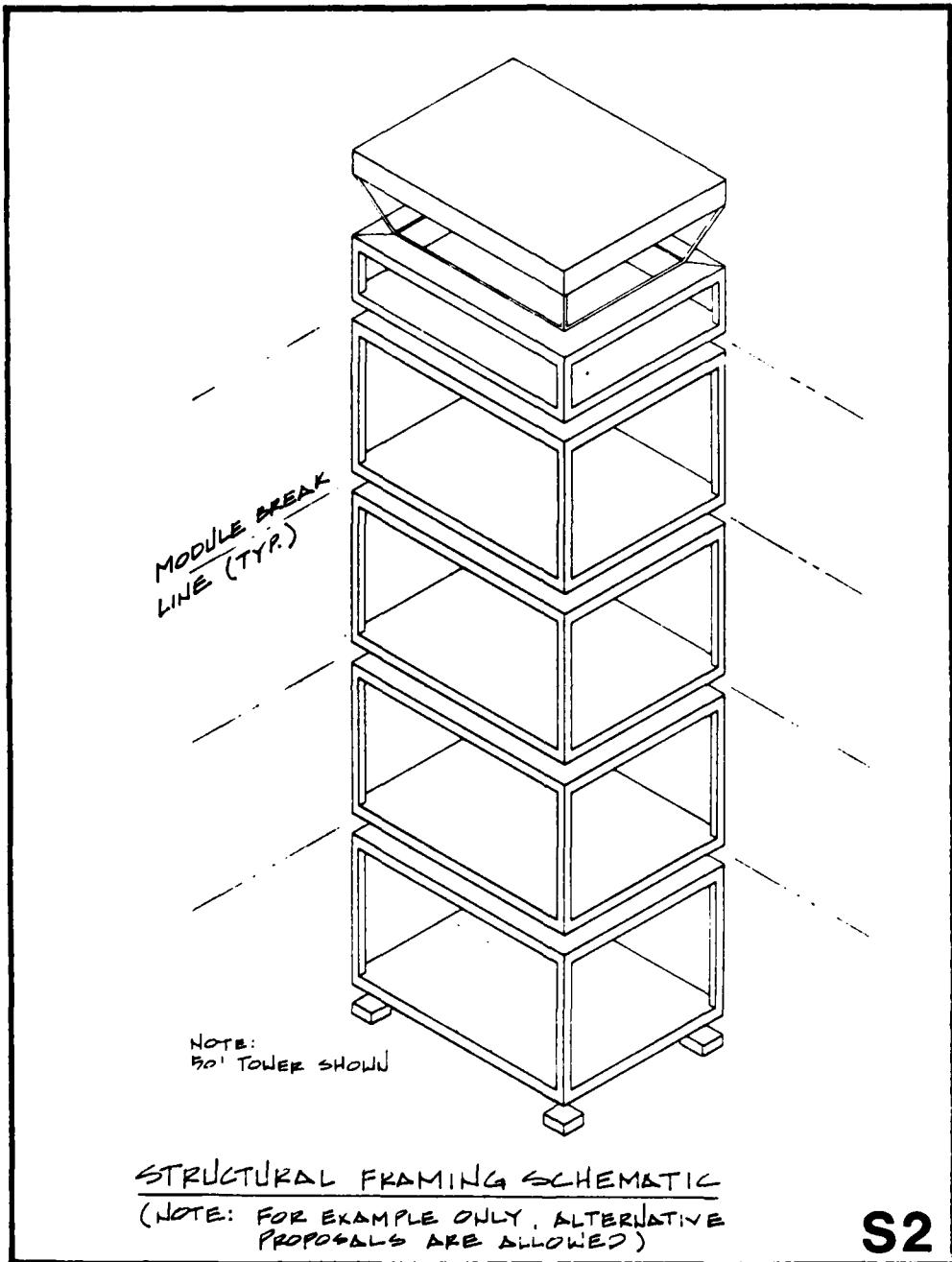


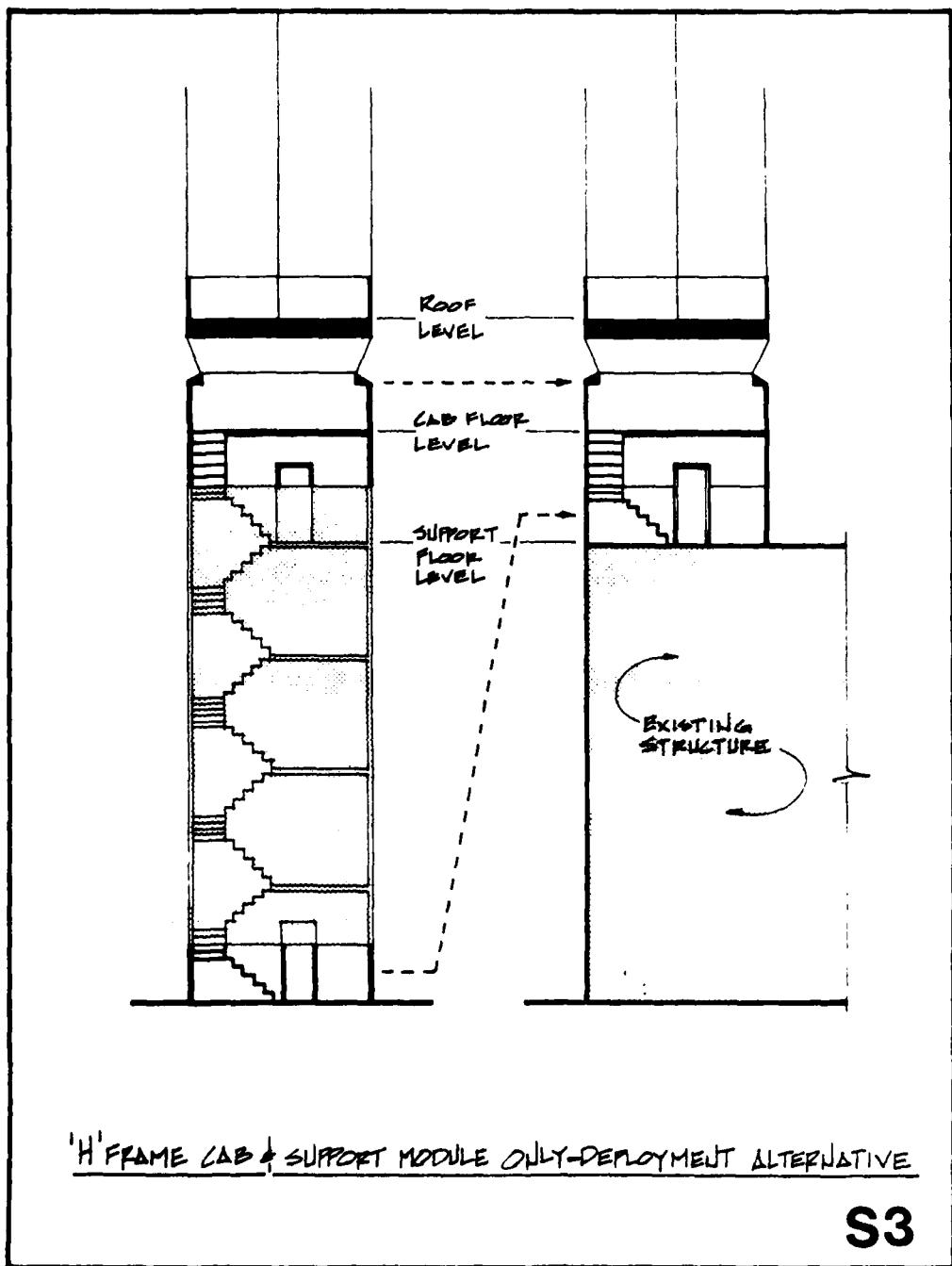


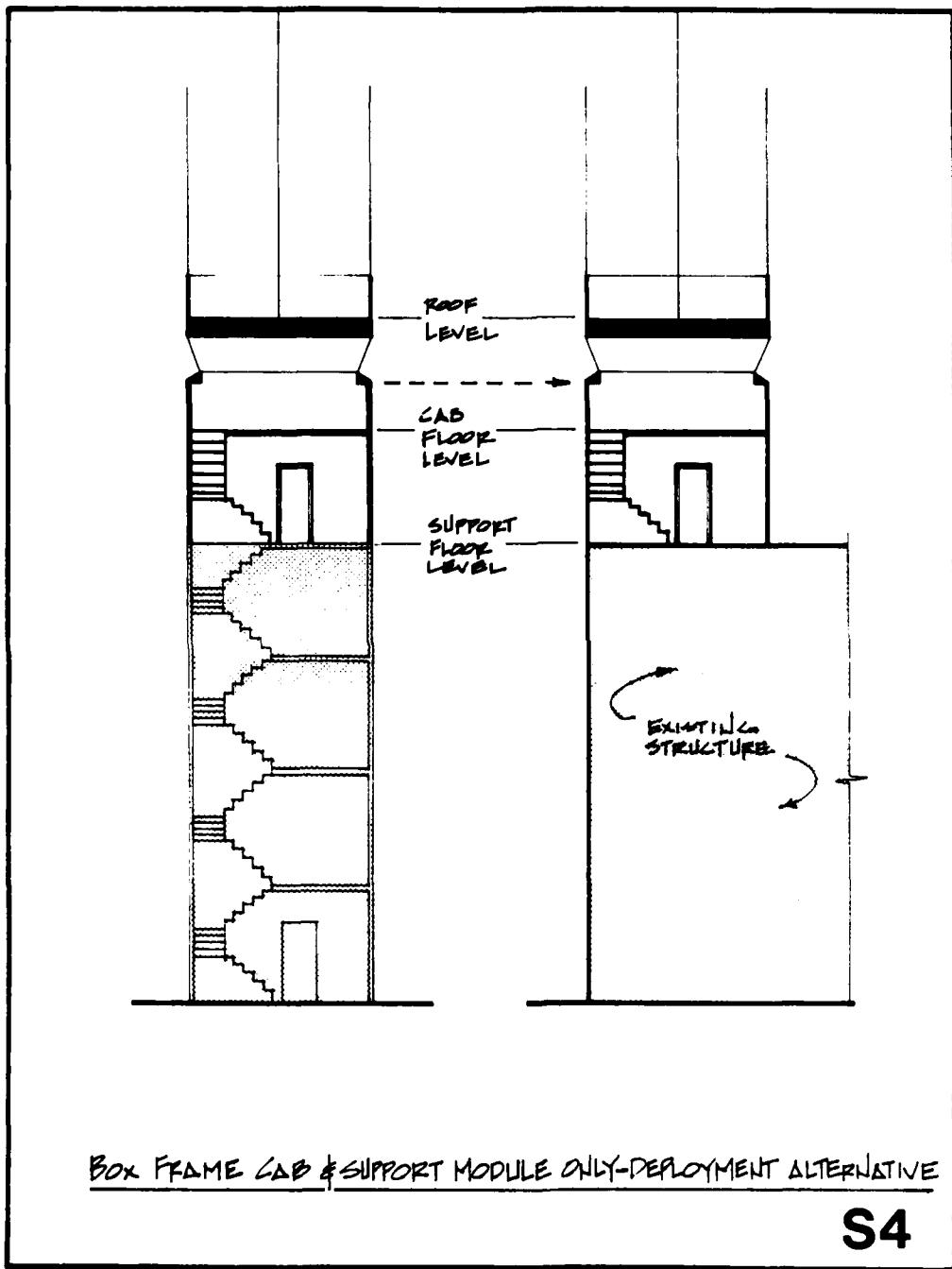


E6





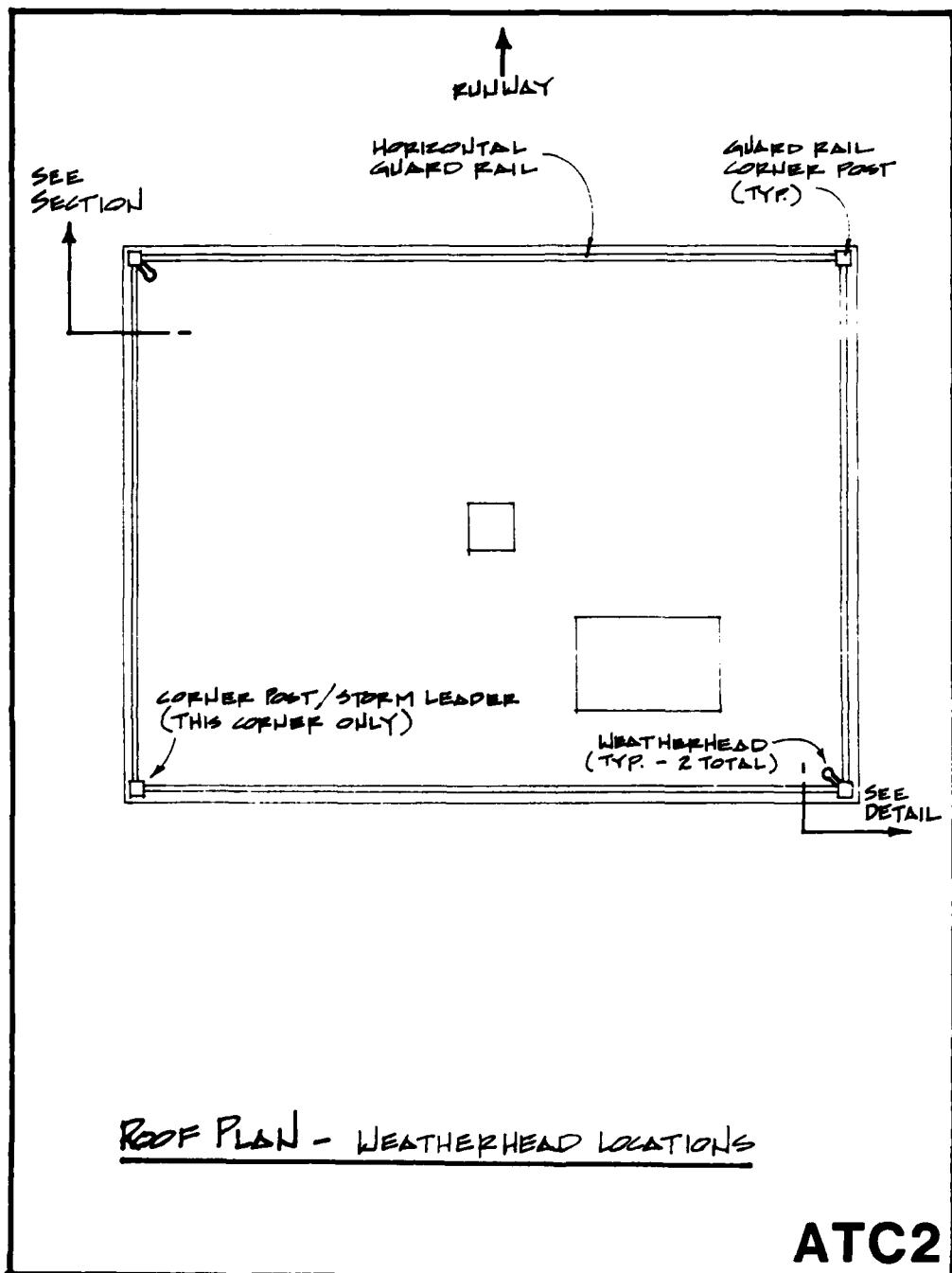


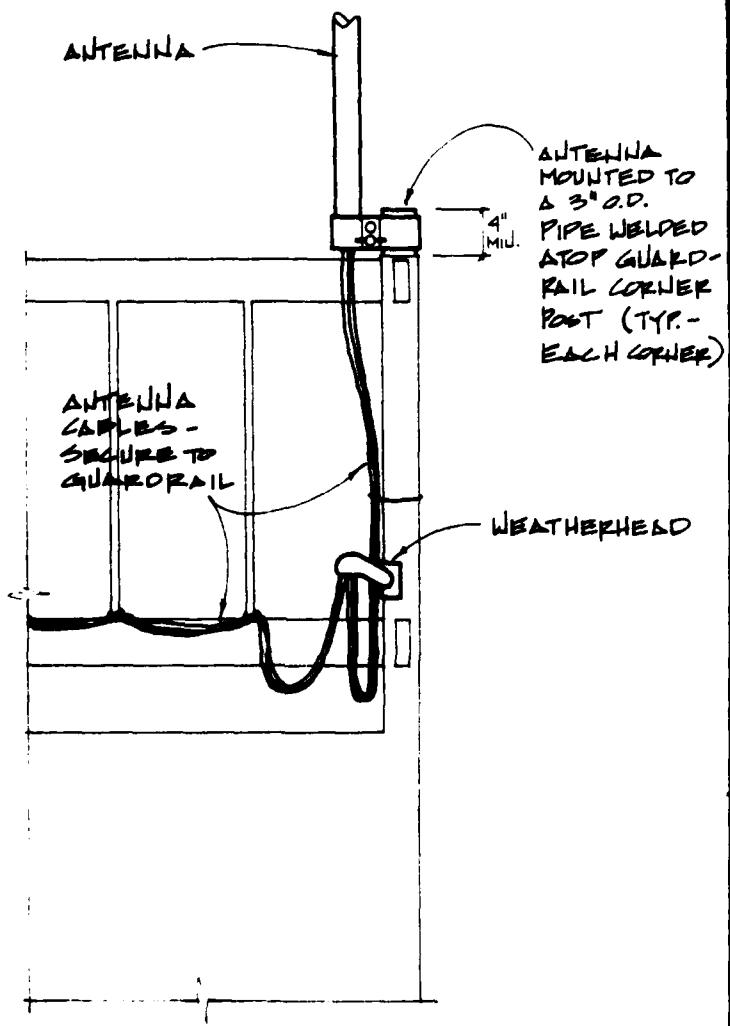


ATC EQUIPMENT SCHEDULE

	<u>Equipment</u>	<u>Remarks</u>
Roof	1 UHF/VHF colinear antenna 3 VHF/FM antenna 1 HF antenna and coupler 1 Anemometer 4 Antenna Mounts	Not in contract (NIC) " " " " " " See Ref. STD - AF - 0640 USACEEIA-ACED
Cab	4 Control equipment consoles (ea 24" W x 27"D x 46"H) w/headsets & microphones 2 light signal guns & reels 2 sets binoculars Log books, flip boots, technical literature Cable trough & Ladder	(NIC) " " " " " " " " " See ATC 2-9 drawings
Support	"	"
Stairwell	"	"
Overhead Canopy (@ ground level)	"	"
Base ATC Module: Equip/Repair	" Recorder, in-cabinet (24" x 25") 3 equipment racks (ea. 22" x 22")	" Must have access to front & back- must be anchored to floor

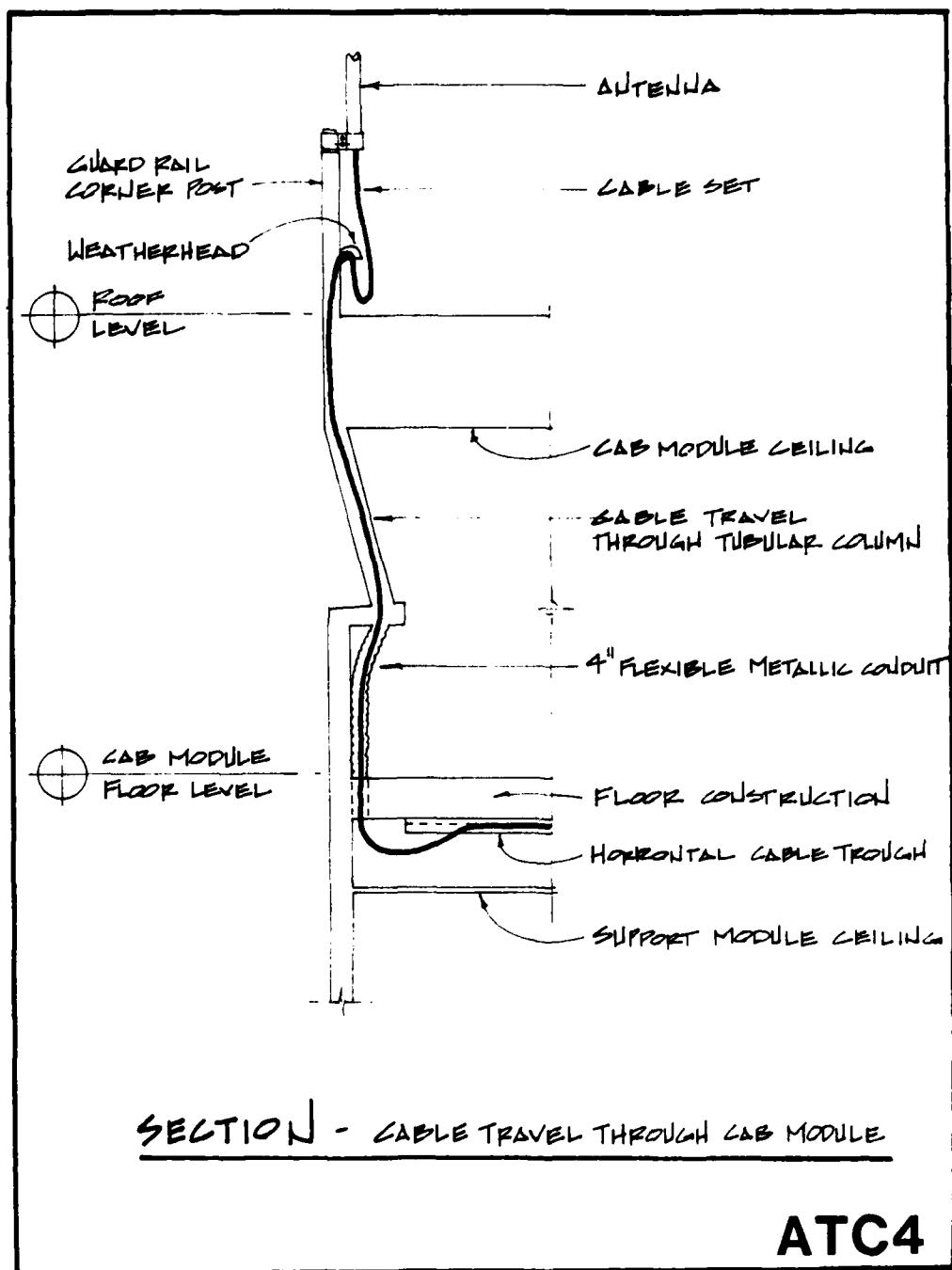
ATC 1



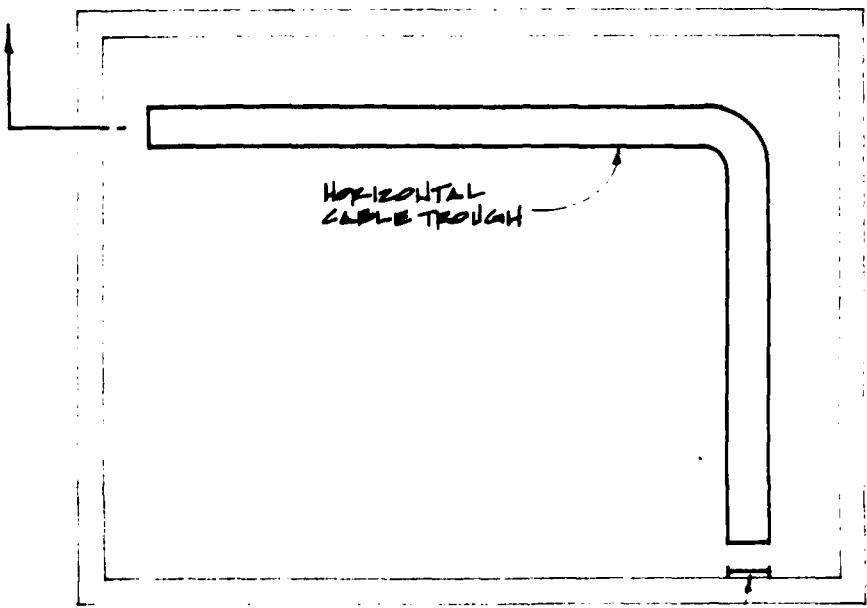


DETAIL - ANTENNA MOUNT / WEATHERHEAD

ATC3



SECTION

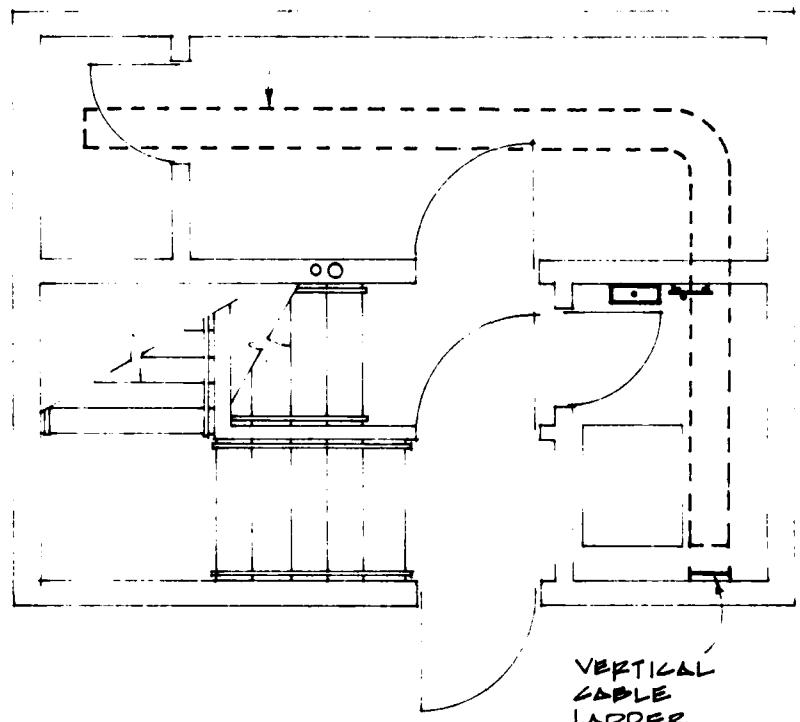


VERTICAL
CABLE
LADDER

SUPPORT MODULE - INTERSTITIAL SPACE

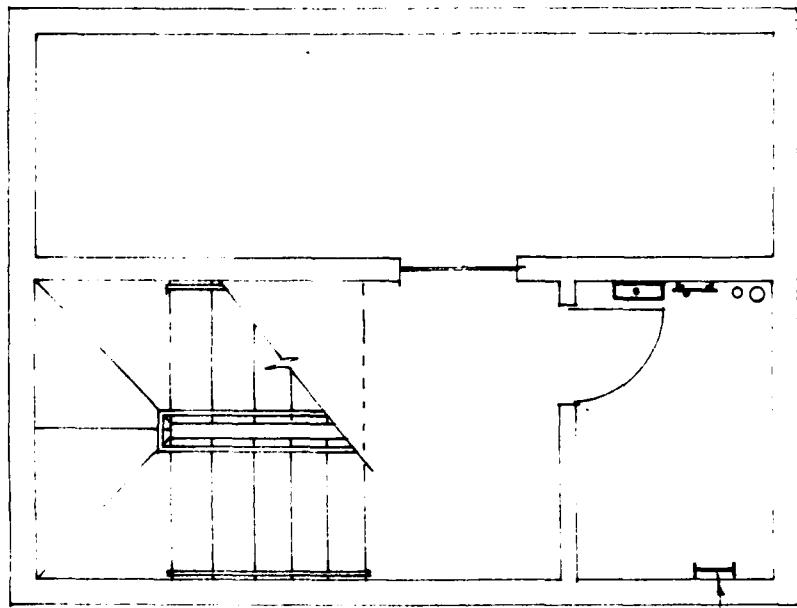
ATC5

HORIZONTAL CABLE TROUGH
IN INTERSTITIAL SPACE ABOVE



SUPPORT MODULE - FLOOR PLAN

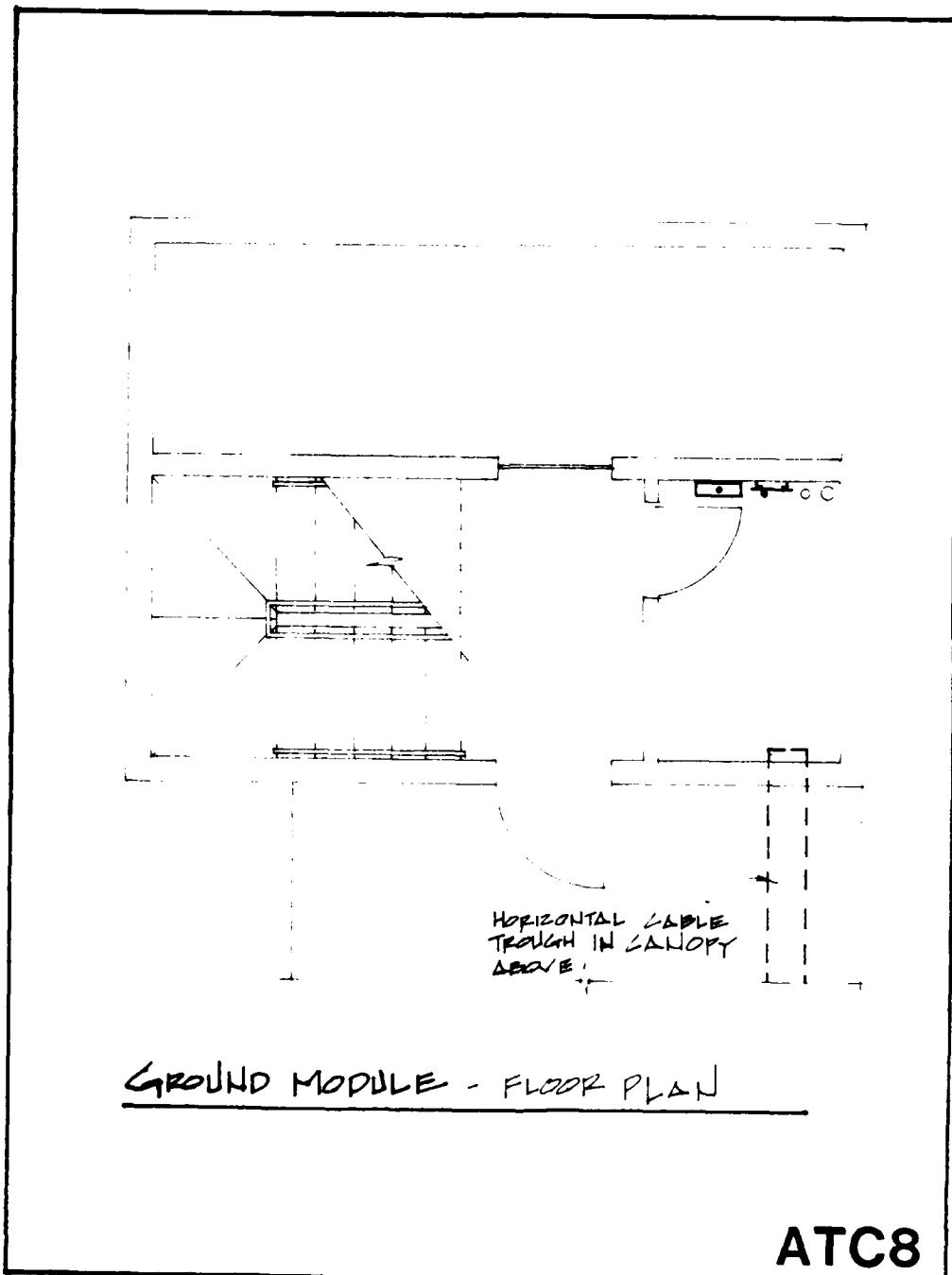
ATC6

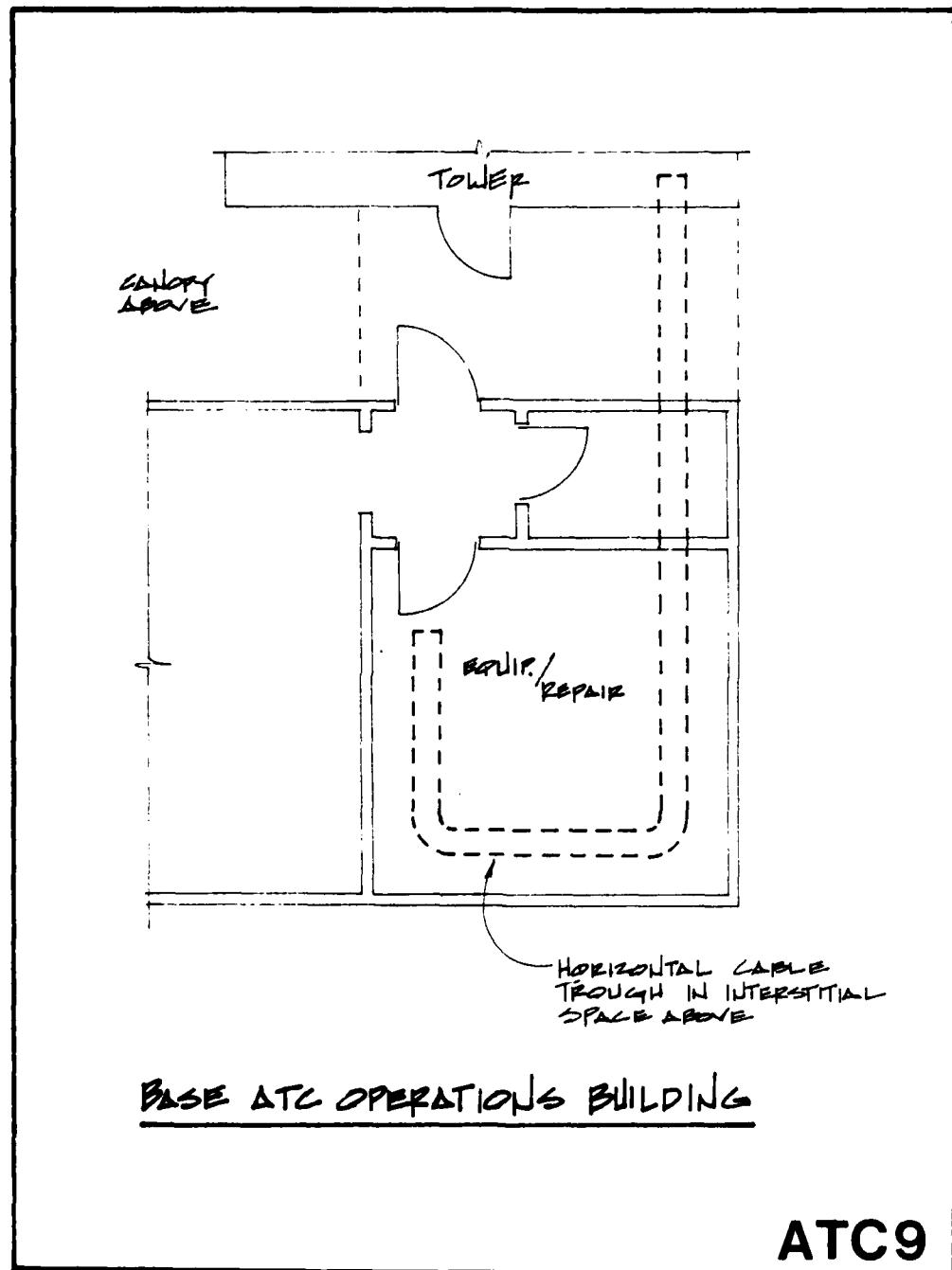


VERTICAL
CABLE
LADDER

STAIR MODULE - TYP. FLOOR PLAN

ATC7





5 STRUCTURAL APPROACH

Type IIIa ATCT structural designs are not intended to be definitive, but rather acquired via a performance-oriented procurement, so that manufacturers and fabricators can develop their own designs. Development of a concept-stage structural and construction approach was intended to:

1. Verify that a modular, prefabricated, transportable approach to this building system is possible
2. Verify that design, fabrication, transportation, and erection of this building system is feasible and reasonable, and can be done within conventional engineering and construction practices
3. Identify reasonable alternatives for solving the engineering problems of these structures
4. Contribute to developing an architectural design compatible with the intended function, construction approach, and acquisition approach.

The structural and construction approach described in this chapter is not intended to prescribe the ultimate configuration of the Type IIIa ATCT. Instead, it exhibits one possible solution that should be allowed when developing procurement documentation.

The structural system selection considerations addressed here are consistent with the objective for the Type IIIa ATCT design. The basic engineering principles of equilibrium, stability, strength, and rigidity are reviewed in assessing structural alternatives. The usual site-specific issues regarding applicable codes, geology, environment, and topography are treated in broad, general terms because of the potential worldwide application of this system.

General Structural Considerations

Geometry

Selection of building form has implications (see Figure 4) on structure and architectural functions. A circle provides the least perimeter for a given area, thus minimizing building enclosure. It also provides the least resistance to air movement, resulting in smaller wind loads, and gives maximum visibility for air controller operations. Floor framing would suggest a radial arrangement; however, there are rectangular options. The integration of stairs and of modular, rectangular controller equipment is quite difficult and implies inefficient use of space.

The peripheral framing requires more than four columns, and therefore more foundation. Defining the geometry of the circle requires either curved beams or a compromise to a polygonal shape. The form may best be constructed of curved, precast concrete sections on a continuous ring footing. The dead load created with such an approach may help to offset overturning from lateral loads. The modules would therefore have to be transported to the site in

sections rather than as completed entities, which would require field involvement.

A rectangular shape has the most perimeter for a given area and thus requires the most building enclosure material. However, its proportions most easily handle the module size limitations imposed by transportation requirements. Structural framing is greatly simplified, making fabrication more economical. Only four columns are required, which reduces the amount of foundation needed. Wind loads are greater than those for the circle and differ about each axis, thus increasing resistance requirements. The architectural functions involving stairs and equipment are accommodated efficiently within the rectangle.

A square shape has implications similar to those cited for the rectangle. It would be difficult to accommodate the required floor area without exceeding transportation dimensional limits. The idea of completed modules becomes unlikely, resulting in greater field involvement.

Structural Material Selection

The framing material must efficiently satisfy the basic requirements of strength and rigidity to assure minimum cross-sectional dimensions and weight. A weight reduction at each level will allow smaller column sections and foundations. This is particularly advantageous at sites where soil-bearing capacity is low. Figure 5 identifies the program requirements as applied to various structural materials. Wood, cast-in-place (CIP) concrete, and lightgauge steel become apparent as less appropriate structural framing choices for the tower's superstructure. Although CIP concrete offers a very suitable foundation choice, its weight and in-place forming costs would rule it out for typical above-grade framing. Its weight would also greatly magnify the seismic design forces. In addition, site-erecting the entire tower would deviate from the modular program requirements and would be time- and labor-intensive.

Wood framing would be inappropriate for the height of structure contemplated and the magnitude of the forces involved. Large cross-sections (heavy timber or glue laminated) are required to classify wood as suitable for unprotected, noncombustible construction. This would reduce usable floor space and head room, as well as complicate connection detailing. Durability and maintenance factors would limit the range of environments for which wood without special chemical treatments might be suitable. Although lightgauge steel is suitable both as a potential floor framing component and a building skin, it would not be structurally efficient to frame the height intended for this application without considerable bracing and stiffening. However, it is lightweight and would minimize foundation requirements. Lightgauge-steel fabricated modules could be transported and lifted into place easily.

Precast concrete components combine strength, rigidity, fire protection, and durability. When assembled in box modules, they would create shear walls that would provide lateral load resistance. The module's major disadvantage is its weight, which would be detrimental for transportation and field erection. The cab level, which has a periphery window system, seems to require structural steel framing; this eliminates the unified, single structural system approach. A precast solution also minimizes adaptability to change

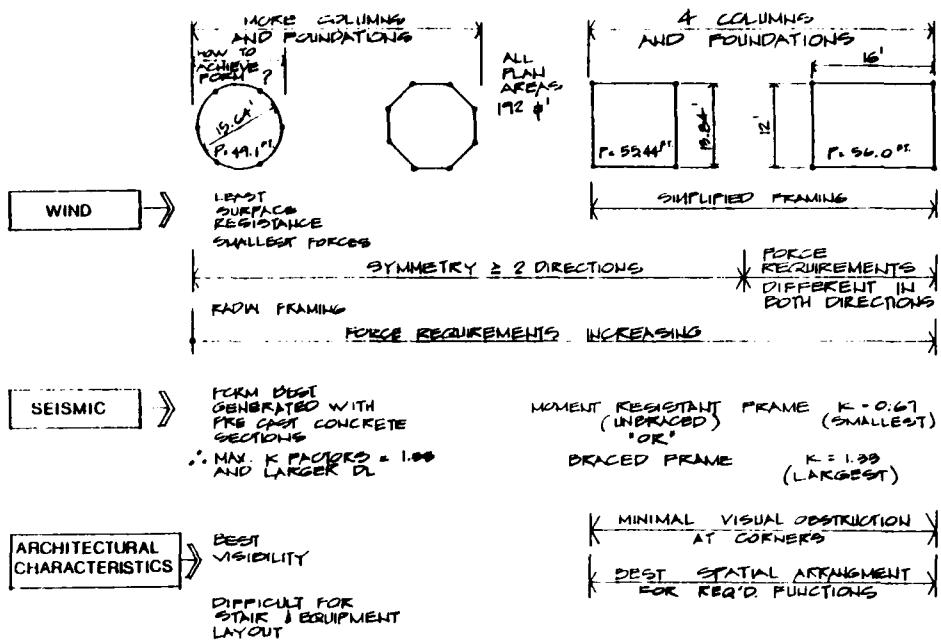


Figure 4. Structural geometry.

MATERIAL	TRANS-PORTABILITY	TROOP-ERECTABLE	WIND/SEISMIC	STORAGE	COST	AVAILABILITY	ADAPTABILITY	
STEEL	REASONABLY LIGHT	YES	MINIMUM FORCE REQ'D IF UNBRACED	MODULE STACKING POSSIBLE		OK FOR MOST GEOGRAPHIC AREAS	VERY FLEXIBLE	
PRE-CAST CONCRETE	HEAVY	YES	FORCE INCREASE DUE TO WEIGHT	MODULE STACKING POSSIBLE		OK FOR MOST GEOGRAPHIC AREAS	MODERATE FLEXIBILITY	
C. I. P. CONCRETE	INAPPROPRIATE FOR:		1. COST OF FORMWORK 2. TIME TO IMPLEMENT 3. WEATHER DEPENDENT			APPROPRIATE FOR:	1. FOUNDATION	
WOOD	INAPPROPRIATE FOR:		1. DURABILITY 2. MAINTENANCE 3. FIRE RATING 4. HEIGHT LIMIT < 60'-0"					
LIGHT-GAGE METAL	INAPPROPRIATE FOR:		1. HEIGHT LIMIT 2. STRENGTH REQUIREMENTS			APPROPRIATE FOR:	1. F. OR FRAMING	

Figure 5. Structural materials.

Connection detailing for precast concrete would be fabrication-intensive for seismic locations.

Structural steel framing satisfies both design and engineering parameters. It is reasonably light, combines strength and rigidity, is easily fabricated into modules, is generally available in most geographic areas, and adapts readily to changes. If environmentally protected from moisture, salt, and other corrosive atmospheres, it is clearly the most appropriate structural material choice. Combined with lightgauge metal joists and decking, it will provide good diaphragm capacity for lateral load transfer.

Lateral Load Resistance Systems

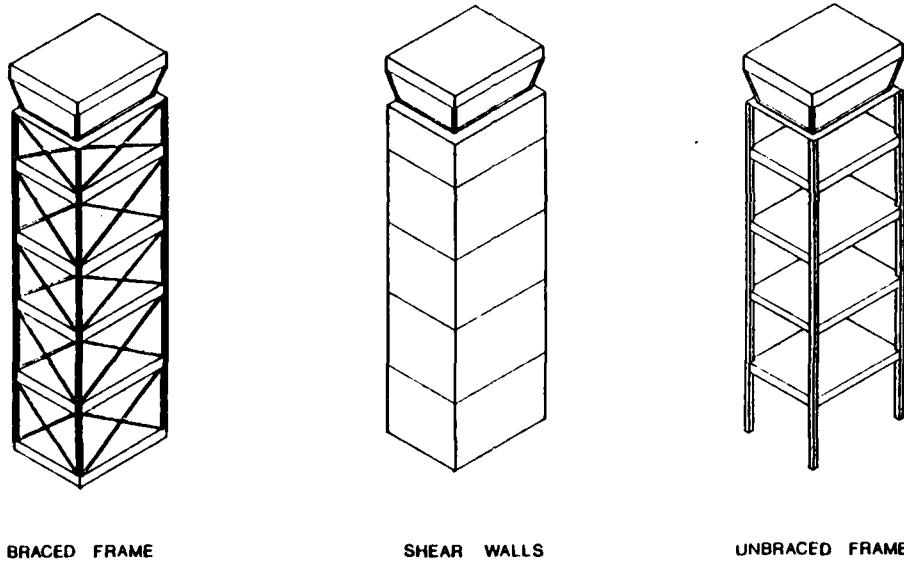
Figure 6 illustrates the three basic categories of lateral load resistance systems considered. The solid shear-wall system category could be made up of vertical diaphragms of wood, lightgauge metals, or concrete (either precast or CIP). Thus, the building envelope serves two functions: (1) structure to resist lateral forces, and (2) environmental protection. Shear wall systems are extremely rigid and have small lateral deflections, so the connection between levels is most critical for proper load transfer. Concrete and wood have already been classified as inappropriate; however, a lightgauge metal skin can be combined with a structural steel framework to satisfy program requirements. Braced steel-frame systems are characterized by axially loaded trussing elements in the form of X, K, or eccentric bracing. Elimination of bending makes optimum efficiency possible by allowing for smaller, lighter cross-sections. Coordination of openings and details around the building envelope is especially critical. The cab level cannot be a braced module because of the windowed periphery. The lateral deflection of braced frames is generally small. Unbraced steel-frame systems provide the maximum flexibility for openings and other architectural requirements. They are characterized by moment connections which transfer lateral forces by bending. They produce larger lateral deflections than shear-wall or steel-braced systems. The major cost factor is in the fabrication of the moment connections. Braced- and unbraced-steel, lateral-load resistance systems are more definitively reviewed in Figures 6 through 13.

Specific Structural Considerations

Load Assumptions

1. Gravity Loads. Gravity dead loads will consist of structural self-weighting, plus the superimposed loads of ceilings, floors, roofing partitions, mechanical equipment, ducting pipes, electrical conduits, and fixtures. Gravity live load due to occupancy will be treated as 100 psf uniformly distributed to each floor. The roof live load is the larger of either a code-specified minimum value or a snow load consistent with geographic location and climatic data (see Figure 7).

2. Lateral Loads. Wind forces or seismically induced forces depend on geographic location, climatological data, and governing code. For this study,



BRACED FRAME

SHEAR WALLS

UNBRACED FRAME

Figure 6. Lateral load resistance.

LOCATION	GROUND SNOW LOAD		WIND VELOCITY PRESSURE			SEISMIC ZONE	
	TM-5-809	ANSI A58.1-82	TM-5-809	ANSI A58.1-82	TM-5-809	ANSI A58.1-82	TM-5-809
WALNEWRIGHT (FAIRDALE) AK	95	95	80	24.84	70	25.5	0 0
BRYANT FIELD AK (ANCHORAGE)	95	15	95	35.0	80	33.5	4 4
FT DRUM (SYRACUSE) NY	40	95	80	24.84	70	25.5	2 1
PT. RUCKER AL (MONTGOMERY)	5 MIN. LL ATLAS	5 MIN. LL ATLAS	90	31.44	80 10 MILES TO GULF COAST	35.24	0 0
PT. IRWILL CA (BARKSTON)	5 MIN. LL ATLAS	5 MIN. LL ATLAS	80	24.84	70	25.5	4 3
KAD TOLTEZ (MUNICH) GER	40	—	90	31.44	—	—	1 —
WERTHEIM (RHEIN-MAIN) GER	25	—	80	24.84	—	—	2 —
FIRMASENS (STUTTGART) GER	40	—	85	28.0	—	—	2 —

Figure 7. Load assumptions.

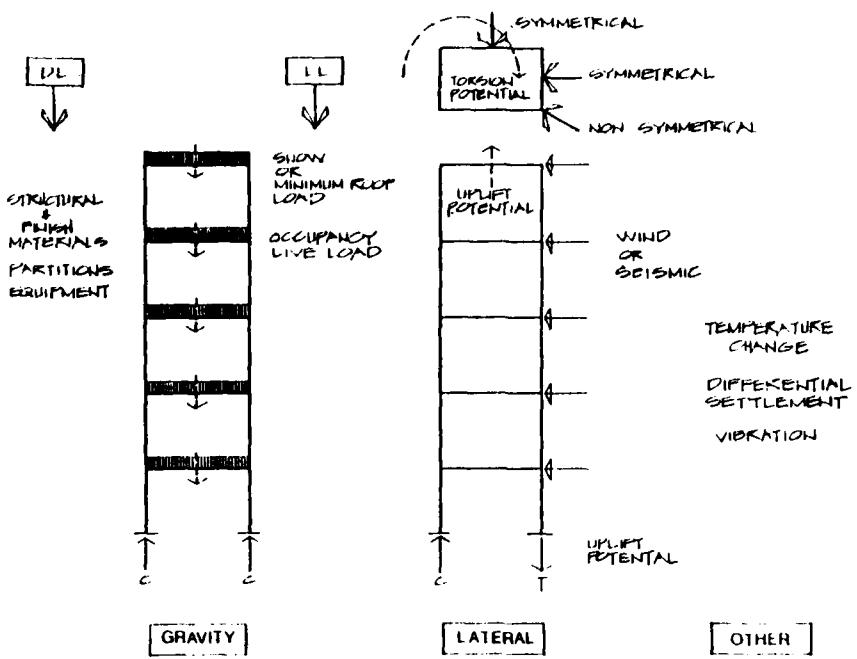


Figure 8. Equilibrium loads.

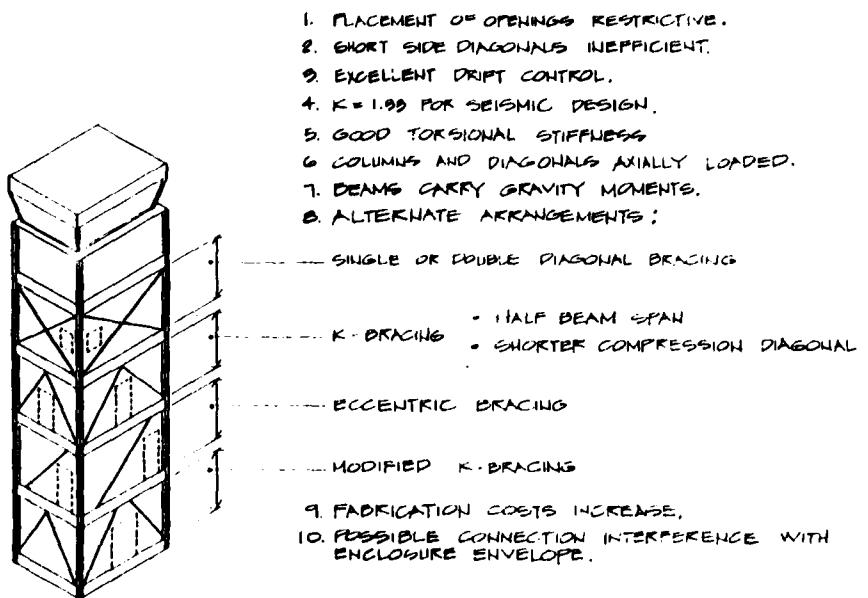


Figure 9. Braced frame considerations.

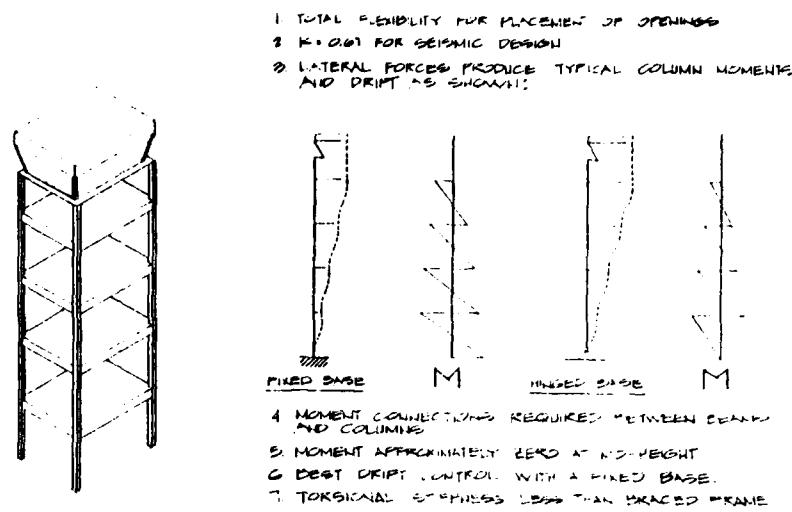


Figure 10. Unbraced frame considerations.

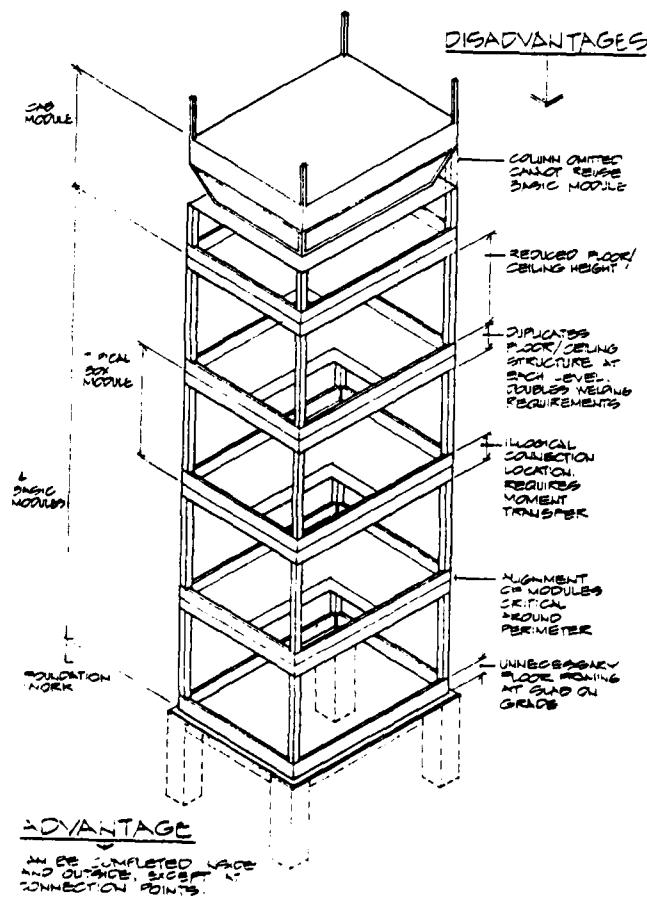


Figure 11. Unbraced frame box module.

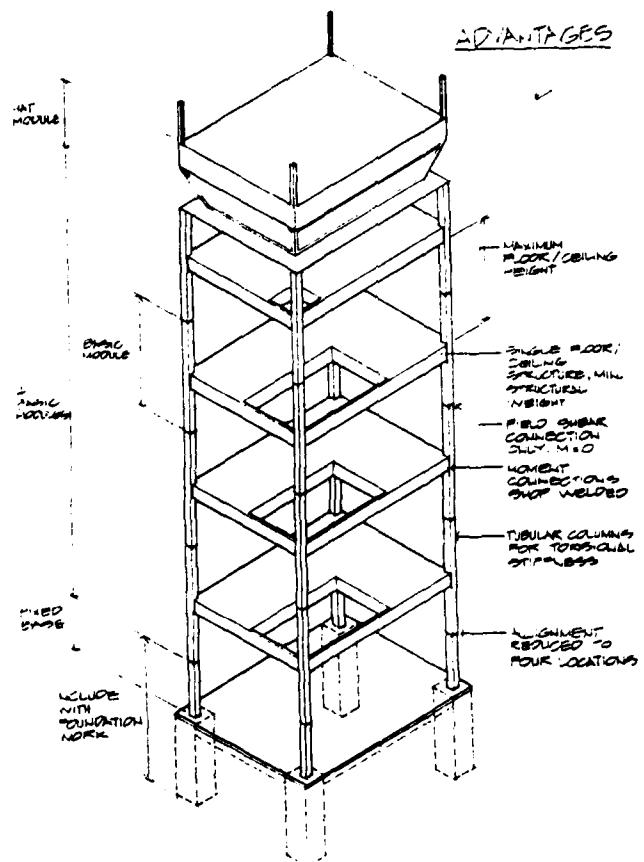


Figure 12. Unbraced frame "H" module.

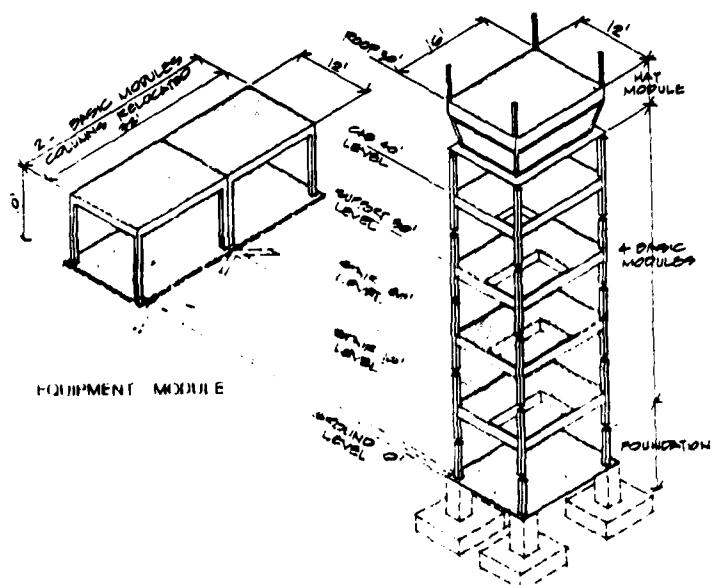


Figure 13. A Type IIIa ATCT construction approach.

values were compared from AFM 88-3, Chapter 1 of TM 5-809-1, and ANSI-A58.1-1982.¹ These comparisons and other calculated values are illustrated in Figure 7. A design wind pressure of 35 psf and a seismic zone 4 were used to develop lateral load values for preliminary member sizing and lateral deflection computation.

3. Other Loads. Temperature change, moisture variation, differential settlement, and vibration will be treated in a general sense, since the facility design will be applied to a range of environmental conditions.

4. Load Combinations. Local codes will dictate consideration of a variety of load combinations. This report will assume DL + LL and DL + LL + LAT.L as its preliminary load cases, where DL = dead load, LL = live load, and LAT.L = lateral load. Figure 8 illustrates the equilibrium implications of these load cases. Two important considerations are evident for tower design. First, as the tower becomes lighter, the up-lift (tension) on the foundation will increase, which will require a tie-down. Second, unsymmetrical lateral loading from wind or seismic sources will produce torsion on the tower, causing additional shear stresses.

Braced Frames/Module Considerations

Figure 9 illustrates three trussing options for braced frameworks. The eccentric bracing type is particularly suited for critical seismic locations. The K-bracing type is structurally efficient in two ways: (1) it reduces the beam span to half and (2) it reduces the length of the compression diagonal. The single diagonal type is inefficient since it must be able to handle all the compression and tension caused by stress reversals. The double diagonal permits sharing of load, but both must be designed to handle compression for seismic-induced force resistance. Assuming the compression diagonal would bend out of its plane and become ineffective, the usual technique of designing the diagonal for tension is structurally undesirable for the rapid stress reversals caused by seismic activity. Neither the single- nor the double-diagonal type reduces the floor beam span. Fabrication of any braced frame involves many pieces and, therefore, more connections. This could result in higher cost as well as potential interference with exterior envelope detailing.

Incorporation of a braced frame for modular construction would require floor-to-floor boxes stacked one on top of the other. The optimum member sizes obtained with a braced frame are compromised by duplication of beams at each floor as well as at grade. Connection between boxes must be able to transfer lateral forces. Alignment between boxes must be continuous around the periphery for proper fit.

¹Air Force Manual 88-3, Chapter 1, "Load Assumptions for Buildings (Reprint, 1 May 69, includes Change 1), 27 Sep 66; Technical Manual 5-809-1, "Load Assumptions for Buildings" (Department of the Army, September 1966); ANSI-A58.1-1982, "Minimum Design Loads for Buildings and Other Structures" (American National Standards Institute).

Unbraced Frames/Module Considerations

Unbraced frames are composed of moment-resistant members and connections and therefore require larger cross-sections than braced frames. Since they are more flexible than braced frames, they can absorb more energy, which is illustrated by the fact that their seismic force factor is half that of braced frames. Figure 10 shows the distribution of moments for lateral load application for two support conditions: hinged and fixed. The major difference occurs within the first level. The fixed base reduces the lateral deflection of the tower and provides better balanced moment in the column. The detail to achieve a fixed-base condition is more complicated and expensive than the typical hinge detail; however, there are only four locations, and this method also anchors the frame against overturning. Torsional stiffness must be provided by floor diaphragms and closed-section columns (tubular).

The incorporation of unbraced frames in a modular scheme produces several options. Figure 11 illustrates the "box" option. It has disadvantages similar to those cited for the braced frames, where due to forces experienced during shipping and erection, the box must be a closed cell. There is duplication of framing at each level, which also reduces floor-to-ceiling heights. Connection between modules at the site requires moment transfer details which are difficult to fabricate and generally expensive. The major advantage to the "box" approach is that both the inside and the outside can be completed in the shop. Field work is reduced to stacking and connecting modules and sealing joints for weather tightness.

Several of the box's structural disadvantages can be eliminated by the "H" option illustrated in Figure 12. The module now becomes one floor/ceiling assembly with columns positioned to end at half-story height above and below. Moment resistance is provided efficiently by full-penetration shop welding, while field connection is made by bolting at only the four points where the column moments are approximately zero. The fixed base is economically created by embedding half-story column sections during the concrete foundation installation. Proper alignment of these four columns is critical. Elimination of trussing provides maximum floor-to-ceiling height and maximum floor area. The basic framework can have its enclosure envelope attached in the shop or in the field. The moment-resistant attribute of each module assures strength and stability during shipment and erection.

A Type IIIa ATCT Construction Approach

Since the development of the previously described design, a need for a tower with a 50-ft cab floor elevation has been identified. However, the overall approach and component relationships described herein still apply.

Configuration

The tower consists of four basic modules stacked above a site-cast concrete foundation with half-story columns projecting above ground level. A "hat" module completes the structural framing. Adjacent to the tower is a Base ATC Operations Building framed by joining two basic modules whose columns are positioned to form a single-story rigid frame hinged to the foundation (see Figure 13).

Basic Module

The dimensions of the basic module will accommodate 2 in. of enclosure envelope thickness, resulting in overall proportions of 16 by 12 by 10 ft. Structural steel tubes are recommended for the columns and peripheral beams to maximize torsional stiffness and strength. Full penetration butt welds (shop-applied) provide the moment connection. Lightgauge metal joists frame the floor, which is then sheathed with a metal deck diaphragm and plywood subflooring. The basic module, including a ceiling and stair run, weighs about 5000 lb (see Figure 14).

"Hat" Module

The "hat" module (Figure 15) stacks on top of the fourth basic module. Its shop-applied exterior envelope consists of operable glazed panels inclined for glare resistance and better ground visibility. The ceiling/roof assembly includes light signal guns and reels, recessed lighting, structural base support for the central lightning rod, and all other overhead equipment required. It is a complete, self-contained module. Corner tubular columns are inclined; besides supporting the roof/ceiling plane, they contain the electrical wiring from above, which is intended to be spliced with the cab module. Corner tubular sections support the periphery railing. A continuous sill plate provides attachment to the corner columns of the cab module below.

Stair Integration

Figure 16 illustrates the prefabricated scissor stair components integrated with the basic module. A landing, landing strut, and lower stair run are shop-connected to each module; the stair section from the landing to the level above is intended to be laid loose within the module and positioned after all modules are stacked at the site. The stair will be an open-riser type with steel grating for treads. Steel channel stringers frame the landing and both stair runs.

Mechanical Integration

Mechanical requirements exist at the ground level of the separate equipment modules as well as within the support, cab, and hat modules of the tower. The tower will have each module prepackaged with electrical conduit lines, soil stacks, gas and water pipes, and ducts. Connection between these items from module to module occurs at mid-height of each level. This provides more convenient access than usual floor or ceiling splices and greatly simplifies general maintenance inspections, future modifications, or repairs (Figure 17). Electrical splices are minimized and, at the support module, wires are brought directly into the electrical panel box. The water closet and lavatory at that level can be floor-mounted.

Enclosure Considerations

The enclosure skin is a structural, lightgauge metal sandwich panel with an insulating core that provides a U-value of 0.05. A typical panel would be manufactured in 2-ft or 4-ft modules with a watertight joint detail. It has a baked-on color finish on both sides that allows ease of maintenance and eliminates additional interior finishes. It is possible to apply the enclosure

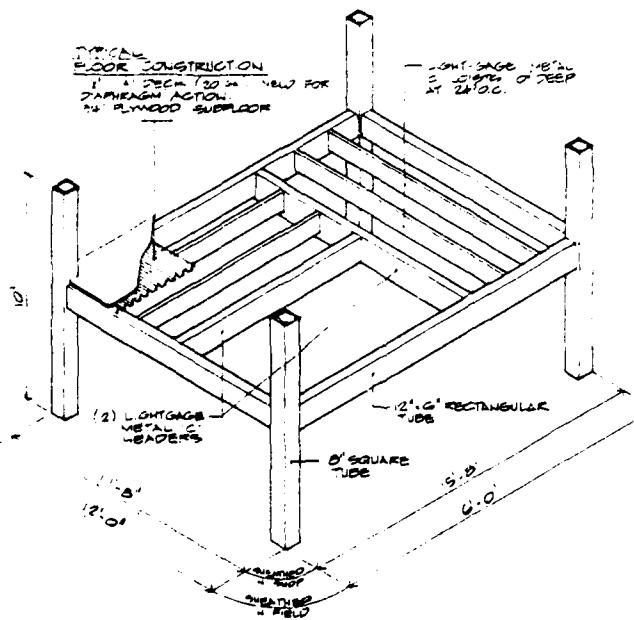


Figure 14. Basic module.

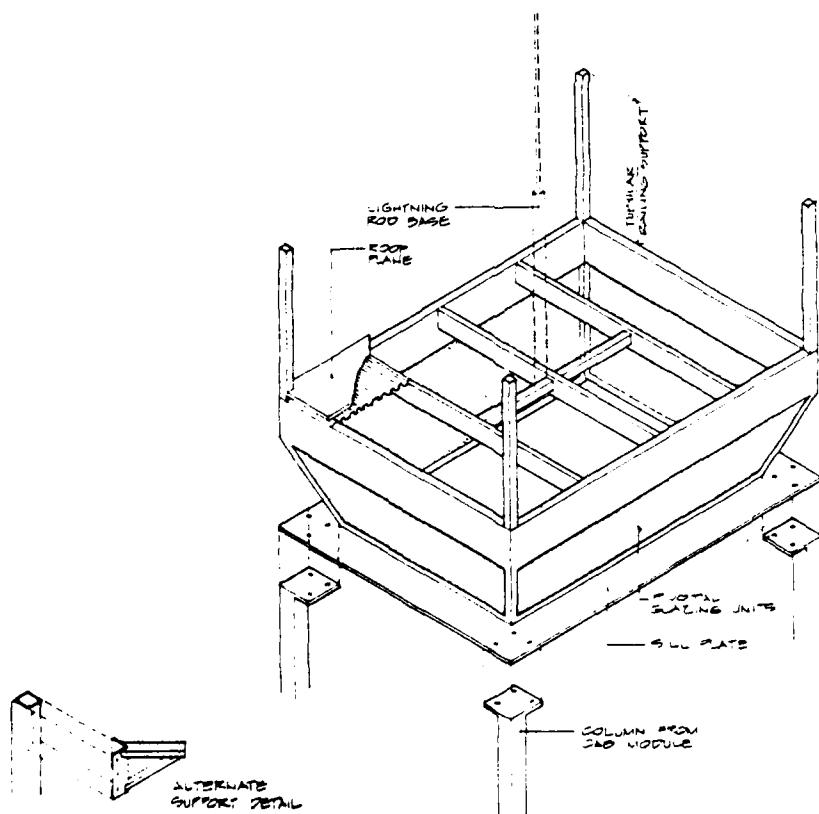


Figure 15. Hat module.

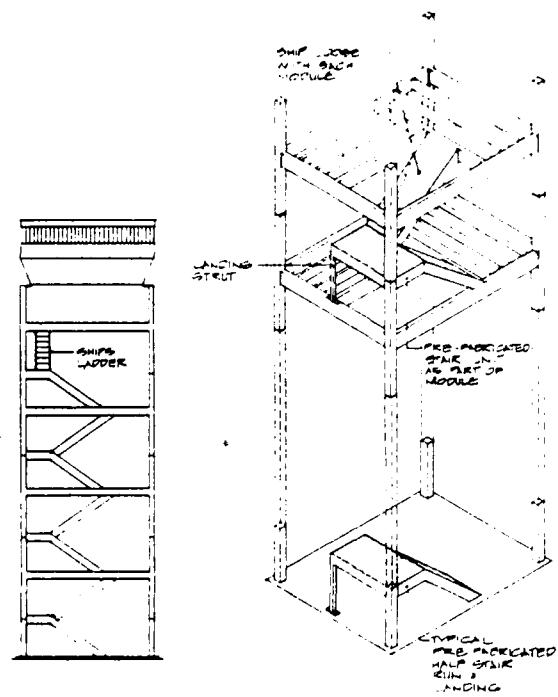


Figure 16. Stair integration.

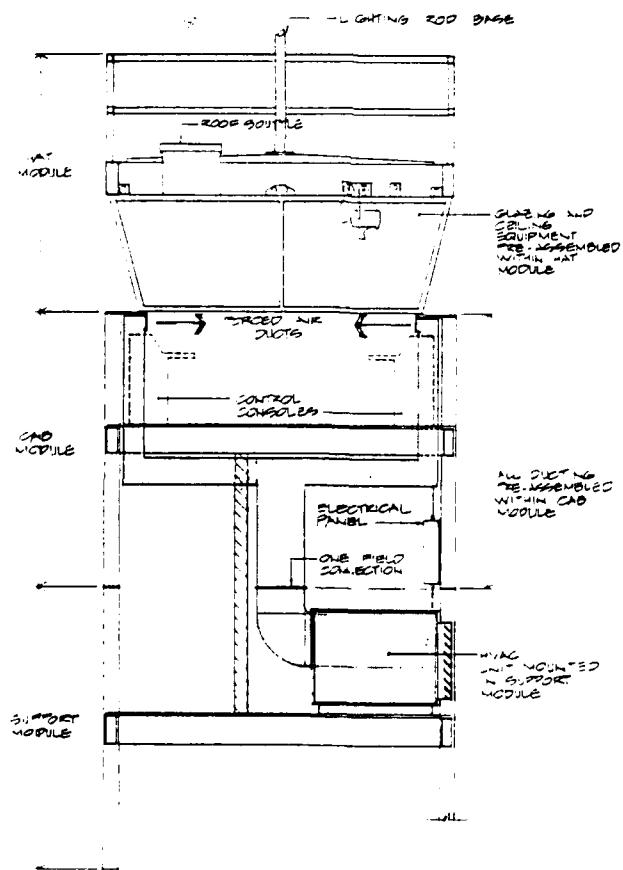


Figure 17. Mechanical integration.

envelope in the shop as part of the basic module's fabrication or to field-apply the enclosure envelope. Figures 18 and 19 illustrate the ramifications of either choice.

The obvious advantages to shop attachment of the envelope involve speed of site erection and the ability to erect the tower in less than ideal weather conditions. However, field work is still required to interconnect the panels at each level and to apply sealants. Proper alignment of modules during stacking is critical to minimize deviations between panel contact points. The accuracy of shop placement will determine how in-line the vertical joints will be. Scaffolding will be needed for these field operations. The half-level height panels at ground level must also be field-installed and sealed. Any part of the surface area can be damaged during shipment and erection; therefore, a protective shield must be shop-applied prior to crating. This shield must then be removed before erection. These two operations are more expensive for panel applications in the shop than for those in the field. Another economic factor involves the extra steel required to provide lateral stability at the top and bottom of each module. This steel would be needed to prevent the wracking involved with shipment and erection, and to provide resistance to wind pressures and suctions.

A total field attachment approach has inherent advantages. The panels are light and can be handled easily since they only span from floor to floor; they are also easy to install. The enclosure for the ground-level equipment modules can also be field-installed easily. The only necessary attachment is to the periphery floor beam; no channels or angles are needed. Vertical and horizontal alignment is accomplished most easily with the structural frames stacked and secured. Regardless of the approach used, scaffolding is required to install flashing and sealant; thus, field work cannot be avoided. Inclement weather is not seen as an issue, since it is doubtful that erection of either type of module (enclosed or not) would be done during high winds, rain, or snow. Emergency installation is also not likely. Under some conditions, field installation may provide the best overall solution (p 106).

AD-A148 848

PROTOTYPE CONCEPT DESIGN FOR US ARMY TYPE IIIA AIR
TRAFFIC CONTROL TOWER (. (U) CONSTRUCTION ENGINEERING
RESEARCH LAB (ARMY) CHAMPAIGN IL T R NAPIER ET AL.

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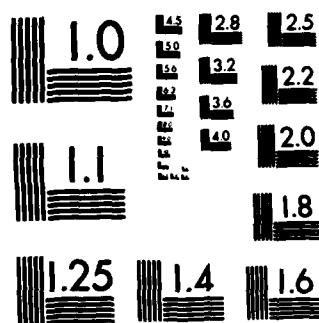
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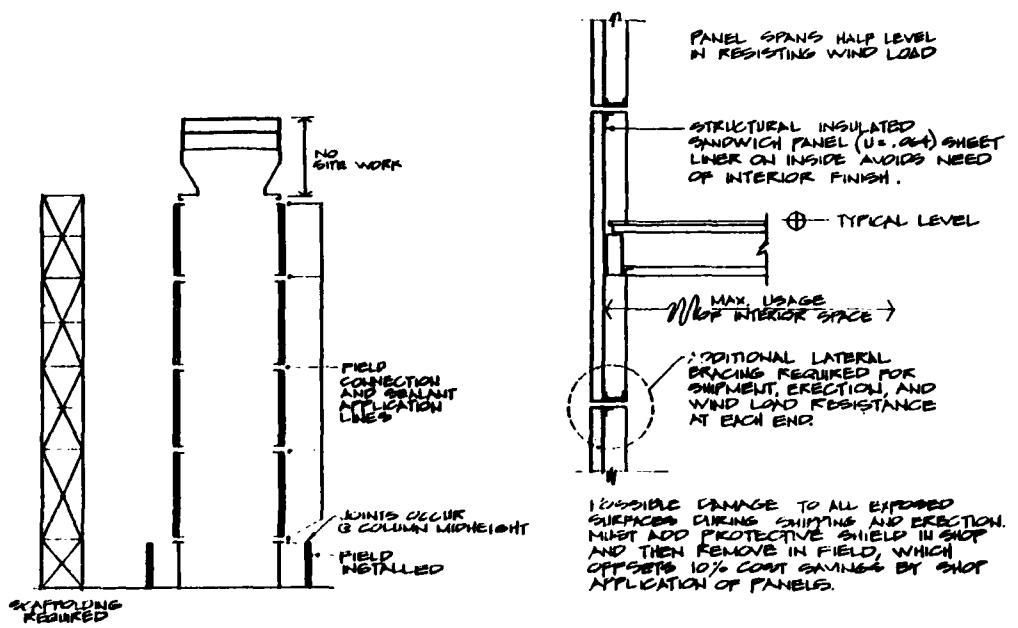


Figure 18. Shop application of enclosure.

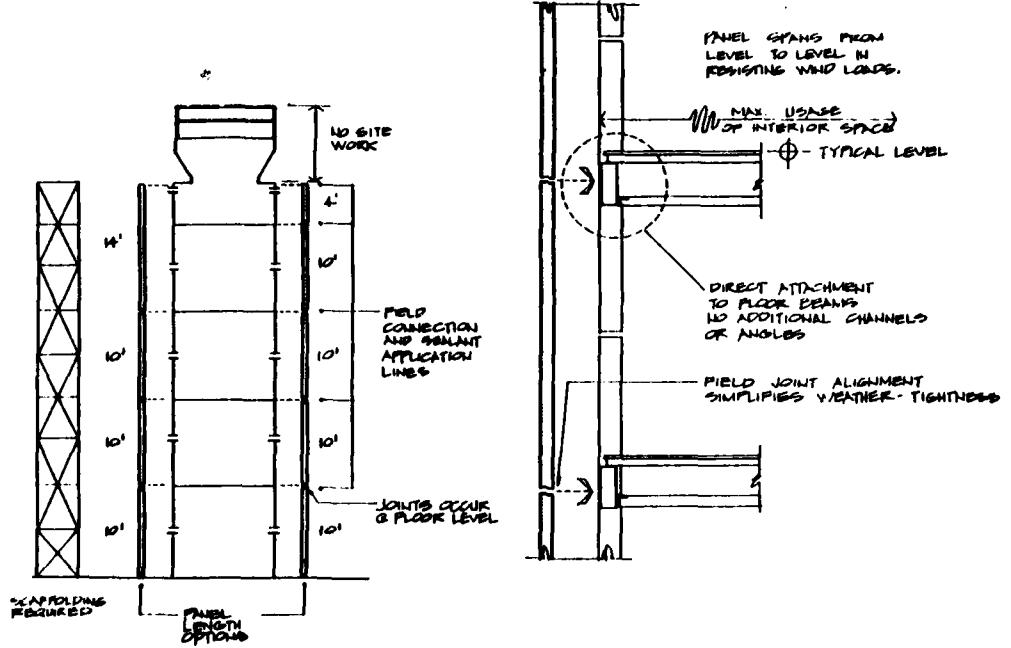


Figure 19. Field application of enclosure.

6 PROCUREMENT APPROACH

Selection and execution of the procurement approach is at least as important to successful completion of a building project as the design itself. The procurement process impacts the ultimate delivery of a usable facility by affecting project economies, acquisition efficiencies, constructibility, and execution of design intentions.

Procurement Method Selection

It is recommended that Type IIIa ATCTs be procured using One-Step Competitive Negotiation or Two-Step Formal Advertising. These methods differ from traditional competitive bidding in that they solicit proposals for executing the design, rather than bidding one single design solution.

One-Step and Two-Step Procurement are both "design/build" approaches, with Two-Step being more widely authorized within the military construction environment. These approaches are recommended because unlike traditional competitive bidding, each allows competition among design and fabrication alternatives within the project. In addition to enhancing competition, this opportunity creates greater incentive for design and technical innovation--a feature sought for the Type IIIa ATCT design. It also allows the competitive marketplace to determine the most economical solution for the project. Furthermore, experience has shown that integrating design with fabrication and construction responsibilities can result in more expedient construction operations and significantly reduce the number of change orders. However, the most significant advantage is seen in the One-Step approach. Contract award is based on factors other than construction cost, such as design quality, technical performance, or energy efficiency. This approach rewards designs exceeding the minimum requirements when they are more advantageous to the Government.

Procurement Procedures

One-Step Competitive Negotiation

In a One-Step approach, the Government advertises a Request for Proposal (RFP). The RFP contains design and technical criteria, but does not prescribe definitive designs and details. Fabricators submit proposals responding to the RFP, accompanied by a bid price for their own proposals. The Government evaluates these proposals for design and technical adequacy (i.e., conformance to the minimum RFP requirements). The proposals are then evaluated for qualities exceeding the minimum requirements. Proposals are "scored" according to a predetermined system that reflects the specific project's necessities and priorities. The proposal exhibiting the cost/quality balance most advantageous to the Government is recommended for contract award; this is not necessarily the lowest bid. After contract award, the contractor completes his/her design, engineering analysis, and construction documents, submits them for approval, and begins with fabrication.

The Corps of Engineers' manual on Turnkey Family Housing² is currently the only formal guidance published on One-Step procurement. Although developed for a different building type, it does provide the methodology and instruction which may also be used for executing a One-Step project for a Type IIIa ATCT.

Two-Step Formal Advertising

In a Two-Step procurement, the Government advertises a Request for Technical Proposal (RFTP). The RFTP contains design and technical criteria but does not prescribe definitive design and details. Fabricators submit technical proposals responding to the RFTP (Step 1). The Government evaluates these proposals for design and technical adequacy and for conformance to the RFTP. Those whose proposals have been evaluated as "acceptable" then submit bids on their own proposals (Step 2). Contract award is therefore based on the lowest bid for an acceptable proposal. The contractor then completes his/her design, engineering, and construction documents, submits them for approval, and begins fabrication.

Policy on the use of Two-Step Formal Advertising is discussed in ER 1180-1-7.³ The Office of the Chief of Engineers has published interim guidance for Two-Step construction contracting,⁴ and USA-CERL has published a report which describes procedures for Two-Step procurement in the context of pre-engineered, or "industrialized" building systems.⁵

It is anticipated that a Corps District would select the Two-Step approach for administering the Type IIIa ATCT. This assumption is based only on the likelihood that a District will be more familiar with Two-Step procurement because it is more widely used in military construction. Further references in this report regarding the procurement approach and documentation will reflect Two-Step Formal Advertising.

Project Execution

The ATCA should approach a Corps of Engineers District to complete procurement documentation and administer procurement and fabrication. This may be done through a District's "One Stop Services Program."⁶

² Procurement Procedure Manual for One-Step "Turnkey" Negotiated Contract for Army Family Housing (Office of the Chief of Engineers (OCE)).

³ Engineer Regulation (ER) 1180-1-7, "One-Step Competitive Negotiation and Two-Step Formal Advertising" (OCE, 1 November 1982).

⁴ Interim Guidance for Two-Step Construction Contracting (OCE).

⁵ T. Napier and M. Golish, A Systems Approach to Military Construction, Technical Report P-132/ADA123382 (U.S. Army Construction Engineering Research Laboratory, 1982).

⁶ ER 420-1-1, "Support to the Facilities Engineer 'One-Stop' Program" (OCE, 15 February 1980).

An initial procurement will consist of a "package" of 10 to 12 Type IIIa ATCT structures. It would be reasonable to approach the District within which most of these structures will be erected, especially if erection will begin as soon as fabrication is complete. Arrangements for subsequent procurements may be made according to what is most reasonable or convenient at the time. The District's responsibilities will include completion of procurement documents (the RFTP), procurement administration, fabrication contract administration, and acceptance and transfer of the product to ATCA.

Procurement Documents

The District should complete the RFTP based on the Prototype Concept Design, functional requirements, and technical criteria outlined in this report. The RFTP must also reflect specific considerations related to the prefabrication, procurement, and deployment characteristics of the Type IIIa ATCT.

Once completed, it is anticipated that the RFTP can be used as a "master" procurement document for future Type IIIa ATCT acquisitions. As with any construction project, no specification should be re-used verbatim without careful review. However, the architectural design will remain standard, and technical specifications should be applicable for virtually all anticipated conditions. Experience with the initial procurement and unique conditions of subsequent procurements will likely suggest adjustments in the design, specifications, or contractual material. However, these adjustments should not involve much effort. Appendix B explains proposal evaluation procedures and displays documentation.

Procurement Administration

The District's involvement in administering a Two-Step procurement will include advertising, proposal/bid inquiries, proposal evaluation, bidding, and fabrication contract award.

Contract Administration

The District's involvement in administering the fabrication contract award should not differ radically from construction contract administration, except for the in-plant nature of the work. Specific considerations will include review and approval of construction documents, quality assurance and/or inspection, delivery and acceptance, and transferral to ATCA.

Anticipated Industry Response

Fabricators submitting proposals should be required to assume single-source responsibility for design, engineering, fabrication, packing and protection and, if possible, transportation. Evidence of such capabilities should be required. These requirements will ensure the contractor's reputation and capability to conduct the work competently and to provide a quality product.

It is anticipated that metal-framed modular building fabricators, metal building manufacturers, and larger steel fabricators will participate in this procurement. The volume of the contract (10 to 12 structures) and the

design's modularity and potential for repetition of parts will make this an attractive contract. Fabricators involved in this sort of work are located in most regions of the United States. USA-CERL can help a District identify potential proposers for this procurement.

7 SPECIFIC CONSIDERATIONS FOR TYPE IIIa ATCT ACQUISITION

Several considerations will be unique to this Type IIIa ATCT project. These relate to the "design/build" approach to the facilities' acquisition, the prefabrication approach, and the potential deployment approaches. These items must be addressed in the RFTP provisions and in the projects' administration.

Considerations for Facility Acquisition

Types of Proposers Sought

To ensure a quality product, the District will want to attract proposals from firms with expertise, capability, and experience in this type of construction. The District should reserve the right to preclude participation by firms which clearly do not have capabilities in this type of project. Although the RFTP cannot imply any sort of prequalification per se, the proposer should be required to show evidence that he/she is regularly involved in fabricating building structures or completed buildings.

Proposer Capabilities

The proposer should be required to assume single-source responsibilities for all aspects of the project. These include design, engineering, fabrication, preservation and protection, and if possible, delivery to the Government. Site erection may also be required where the structures are to be erected immediately after fabrication.

Professional Qualifications

The proposer should be required to submit the appropriate professional certification for all architectural, structural, mechanical, and electrical design. A proposing firm may have these capabilities on-staff or may contract for them.

Multiple Proposals

Proposers should be allowed--even encouraged--to submit more than one proposal showing different approaches to the ATCT design.

Proposal Documentation

The District must require sufficient material in proposals to ensure a reasonable evaluation of their design and technical qualities. However, proposal requirements should not be so extensive that they create an unnecessary burden on proposers and thus discourage participation. Appendix A gives a suggested list of required proposal submittals.

The RFTP must clearly describe required proposal submittals. This description should indicate the item to be submitted, its format, and the information it is to include. This will expedite proposal evaluation by

reducing requests for clarifications and requests for additional information and by presenting material consistently among proposals.

Maximum Cost

The District should identify a maximum cost for the fabrication contract, above which a bid will be rejected. This will identify the expected level of expenditure and help ensure that the project remains within budget.

Considerations for Fabrication

Prefabrication Approach

Many design and engineering solutions can be developed for a modular pre-fabricated building system such as the Type IIIa ATCT. This is the main reason why a design/build, performance-oriented approach is recommended for this project. A typical engineering approach would be to use volumetric, box-type modules, although the "H-shaped" structural modules may be a significant improvement. However, either of these concepts, as well as other approaches, should provide a satisfactory product, if developed adequately. Thus, the RFTP must clearly describe a proposer's opportunities and constraints.

Degree of Prefabrication

The RFTP must clearly describe the extent to which the building system is to be prefabricated. It is essential that all proposals be based on the same degree of completion when delivered, and thus represent the same expense for site erection.

ATCA originally intended that the Type IIIa ATCT building system be pre-fabricated as much as possible, stored, transported to the site, and erected. However, in some situations, this degree of completion may provide no particular advantage and may even be disadvantageous and less economical than if some tasks were completed on-site. These situations are discussed on p 106.

"Complete" prefabrication means that each building module is complete and ready to be placed and connected. The module will include the superstructure, stairs, floor, exterior walls, ceilings, interior partitions, and finish surfaces. All mechanical equipment, mechanical distribution, electrical equipment, electrical distribution (conduits and wiring), plumbing distribution, and fixtures will be in place and ready for connection to the interfacing modules. All equipment and accessories that are to be provided by the fabricator will be in place. All ATC raceways will be in place, as will all anchorage or accessories required for ATC-provided equipment, such as antennae or instruments. All components will be secured and protected to resist transportation and erection forces. Items that must be installed on-site include the fire escape balcony and ladder, lightning rod mast, canopy between the tower and Base ATC Operations Building, fasteners, connection accessories, and other miscellaneous accessories. Other requirements are protection of the modules for transportation and storage, provisions for handling, and packaging and packing of unattached items.

Sometimes it may be more advantageous to install the exterior wall panel system on-site. If this is the case, all interior construction would be installed and secured as described above. Any items normally attached to the inner surface of the exterior wall, such as electrical distribution, would now have to be supported independently of the exterior wall. All wall panels would have to be pre-fit and piece-marked for location. Accessory items such as vents, grills, or fixture boxes would be pre-installed.

In situations where both building system fabrication and site erection could be administered under one contract, the issue of prefabrication becomes secondary. The general contractor responsible for the total project will develop a prefabrication approach best suited to the project conditions and his/her operations.

Transportation Regulations

The Prototype Concept Design was developed around the concept of prefabricated transportable building modules. The dimensions and configurations shown should accommodate this approach. However, the RFTP should require the contractor to be responsible for researching applicable transportation regulations and developing a design consistent with those regulations.

Adequacy of Design

The District will ensure the adequacy of all elements of the Type IIIa ATCT design by reviewing and approving design and fabrication documents before beginning that phase of fabrication.

Fast-Tracking

If time for fabrication is limited, the District should consider allowing the fabricator to phase operations with completion of final construction documents. An example would be approving structural documents for fabrication while shop drawings for the exterior wall panels were still pending or while mechanical design was still in progress. This process will save time in comparison to the method of approving all construction documents before beginning any fabrication operations. These provisions must be described in the RFTP, since they will affect a proposer's anticipated schedule, and thus the bid.

Fabricator Quality Control

It is especially critical in prefabricated construction to maintain careful control of fabrication quality. Unlike conventional site-built construction, there will be few opportunities to compensate for inaccuracies. Of specific concern are the following items:

Fabrication tolerances

Proper fit: module to foundation

Proper fit: module to module

Proper fit of ancillary items

Protection and preservation of shipping, storage, handling, and erection

Maintaining tolerances during shipping, storage, handling, and erection

Adequacy of erection data and instructions

Adequacy of operation instructions

The District may implement a Quality Control/Quality Assurance (QC/QA) program similar to that used in a conventional construction project. The RFTP must describe the contractor's responsibilities for developing the QC program, Government approval, Government QA provisions, and acceptance.

Government Acceptance

It is recommended that the fabrication contractor be responsible for the Type IIIa ATCT building system as long into the fabrication/storage/erection process as possible. It is likely that the building system will change possession at least three times among the fabrication contractor, ATCA, and the site erection contractor. Wherever the continuity of responsibility is broken, there is increased chance of damage, lost items, improper operation, untimely shipment, and other logistical problems. The many participants would make assessment of responsibility very difficult.

It is recommended that the Government accept the prefabricated building system at its storage location or, if erected immediately upon fabrication, at the erection site. Acceptance at the factory is discouraged, since this will introduce one more potential source of breakdown (transportation) into the process.

Conversely, the Government should transfer responsibility for the building system to the site-erection contractor as early as possible. If the storage depot is a reasonable distance from the erection site, it may be appropriate to include transportation to the site in the site-erection contract.

The objective here is not to make it easier to enforce penalties but rather to prevent problems. This can be done by making fewer parties responsible for greater portions of the work. These provisions must be described in the RFTP.

Damage to Work

The RFTP should describe the contractor's responsibility for damage which occurs before Government acceptance of a job.

Systems Testing

Mechanical, plumbing, and electrical systems should be tested as much as possible before Government acceptance. This will help prevent defects from being passed to the Government and then to the site erection contractor. Testing requirements might also encourage making mechanical, plumbing, and electrical configurations essentially independent within each building module. This would be a desirable characteristic.

As-Built Drawings

The District should require the contractor to submit final engineering analyses, construction documents, and specifications upon completion of the work. Copies should be forwarded to US Army ATCA and to USA-CERL. These requirements must be described in the RFTP.

Erection Instructions

Since the fabricator may not be involved in the site erection of the building system, it is critical that the site erection contractor have complete and accurate erection instructions. These should indicate proper foundation anchorage design and interface; module handling and lifting; module connections; attachment of ancillary items; mechanical, plumbing, and electrical attachments; finishing; and all necessary data on the building system and its equipment. These instructions should be reviewed and approved before Government acceptance. Provisions for the instructions must be described in the RFTP. It may also be appropriate to secure copies within the cab module at the plant.

Although the Type IIIa ATCT need not be designed to be "relocatable" in the strictest sense of the word, capability to dismantle the modules is desirable. Dismantling instructions should also be included.

Comprehensive instructions will also contribute to site-erection economy. A contractor will have less risk when developing a bid and will therefore be able to reduce the contingency factor.

Copies of the instructions should be forwarded to U.S. Army ATCA and to USA-CERL.

Operation Instructions

Comprehensive instructions for mechanical systems and other equipment should be provided with each ATCT structure. It may be appropriate to require critical data and instructions to be mounted permanently within the mechanical rooms and at other appropriate locations. This would benefit the ATCT users because of (1) the tendency of printed material to get lost, (2) the degree of user control of the mechanical systems, and (3) the likely remoteness of the ATCT structure from the base installation and Facilities Engineer's Office. The RFTP must describe these requirements.

Fabricator Involvement in Site Erection

It is suggested that the District develop provisions, if practical, for the fabricator to provide a representative to the Government or to the site-erection contractor during site erection. This should not be expensive, and may prevent erection problems or expedite their resolution.

Considerations for Deployment

Many of the considerations described above will have to be resolved between ATCA and the District during procurement. These will depend mostly on the numbers of ATCT structures being procured, the timing, and the means by which ATCA will deploy them.

Design Alternatives

The Type IIIa ATCT can be deployed in a variety of configurations. The basic ATCT design accommodates tower heights of 30 to 60 ft (cab floor heights

of 20 ft to 50 ft) and the Base ATC Operations Building configured in one, two, or three modules. ATCA has identified other possible design configurations for this building system.

There may be cases in which an existing building may be of the proper location, height, and structural capabilities to enable placement of a structure on its roof. In this case, the cab module and support module alone could be used. The fire escape door would now be the access to a two-module tower. All necessary mechanical, sanitary, and kitchenette functions would be self-contained in the tower structure.

There may be cases, especially overseas, where the numbers of towers, locations, or local economies would make it more advantageous to ship only the cab module and to site-construct the rest of the tower shaft and base building. This would be feasible, since this Prototype Concept Design is a standard architectural design, as well as a plan for a building system and acquisition approach.

Deployment Scenarios

There are essentially two ways to deploy the Type IIIa ATCTs. ATCA's initial intention was that the ATCT "packages" be fabricated, placed in storage, and deployed when and where needed. However, a second scenario is also feasible, in which the ATCT structure would be erected directly upon fabrication, without the interim storage phase.

If the ATCT structures are to be fabricated, stored, and then deployed to a location that has not yet been determined, the acquisition approach should reflect the following considerations.

Degree of Prefabrication. It is suggested that the Type IIIa ATCT package be prefabricated as much as possible before the Government accepts it. Complete prefabrication will result in fewer separate components leaving the factory, which will reduce the likelihood of transportation and/or shipment coordination problems. In addition, storage and inventory management will be simplified. Complete prefabrication will also reduce the chances of including wrong components in the package, poor fit, mismarked components, or missing components. These considerations become especially critical because responsibilities for the structure will be transferred among several parties and because of the possibility of construction in remote locations.

Packaging and Packing. Since the erection site is likely to be unknown at the time of fabrication, the modules will have to be packed, packaged, and preserved to withstand the worst anticipated deployment conditions. This means deck-top OCONUS shipment will have to be used, which will incur additional cost. ATCA must assess the likelihood of overseas deployment and indicate these requirements to the District. It may be less costly to pack, package, and preserve the modules for CONUS conditions, and re-package only those to be shipped OCONUS.

Spare Parts. Since site erection is likely to be remote from fabrication in both distance and time, it is recommended that an ample supply of spare parts be included with each ATCT package. These may include structural fasteners and accessories; mechanical, plumbing, and electrical connectors and accessories; wall panels; and other components likely to be damaged or lost during handling or erection. ATCA should also consider procuring an inventory of critical parts that may be difficult to obtain quickly. This will expedite erection if components are damaged or lost during deployment.

Government Acceptance. It is suggested that the Government accept the Type IIIa ATCT prefabricated building system at the storage location.

Design Configurations. It is assumed that a deployment location could require the complete building system--a 60-ft tower and a three-module Base ATC Operations Building. The procurement will be for a designated number of complete Type IIIa ATCT structures. Any other design, design configuration, or combination of modules required should be identified to the District.

Acquisition Considerations

If the ATCT structures are to be erected as soon as they are fabricated, the following considerations should be reflected in the acquisition approach.

Degree of Prefabrication. Logistics become somewhat less critical than when site erection is so remote from fabrication. It may be more advantageous and possibly even less costly to install the exterior wall panel system on site; this would reduce vulnerability to damage in transit. It would also simplify structural connections of the modules, better compensate for irregularities, and allow easier sealing of panel joints. Given the specific locations and conditions of this deployment scenario, ATCA and the District should determine the suitability of this approach.

Packaging and Packing. It is assumed that ATCT structures which will be erected directly upon fabrication will be erected in CONUS. Therefore, packaging and packing need only protect the building system between the fabricator's plant and the site. This packaging should include protection from inclement weather, since placement in covered storage would be unlikely.

Spare Parts. It is recommended that an ample supply of spare parts be included with each ATCT package. These need only include assembly accessories, since more major components ought to be available from the fabricator, the fabricator's suppliers, or other local sources.

Government Acceptance. It is recommended that the Government accept the Type IIIa ATCT building system at the erection site. Furthermore, the District should consider having the fabricator transfer the ATCT package directly to the site-erection contractor.

Design Configurations. ATCT must inform the District of each site's design configuration requirements (i.e., the required tower height and the Base ATC Operations Building configuration). The District must also know if any more modules or components will be required later.

If all ATCTs to be procured will be located in the same vicinity and are to be erected directly upon fabrication, the District should consider administering the total project as a single design/fabricate/construct contract. The feasibility of this approach will depend on the numbers of towers to be acquired under the contract, the geographic proximity of the sites, and the fabrication and erection capabilities of the construction industry in that locale.

8 PROCUREMENT DOCUMENTATION

The procurement document for a Two-Step procurement is a Request for Technical Proposal (RFTP). This document contains the contractual, design, and technical requirements from which the fabricator will develop a proposal and definitive design. The RFTP is the binding contract document. The suggested contents and format of the RFTP for the Type IIIa ATCT are as follows:

- I Request for Technical Proposal
- II Instructions to Bidders
- III Special Instructions to Bidders
- IV Contract Documents
- V General Provisions
- VI Special Provisions
- VII Technical Specifications
- VIII Drawings

A brief explanation of these sections follows; Appendix A provides an expanded outline.

The "Request for Technical Proposal" section is a general introduction to the project and a statement of the work required in this procurement. It will include a description of the Type IIIa ATCT project requirements and brief descriptions of the procurement procedures and basis for award, the proposer's options and responsibilities, and the use of the RFTP document. It should also contain general information regarding the procurement schedule and administration.

"Instructions to Bidders" is a standard construction contract item.

"Special Instructions to Bidders" contain instructions specific to the particular procurement. These should include standard special instructions typical of most conventional projects. They should also include a full explanation of the procurement process, proposal preparation, proposal submittal, evaluation process, and other instructions for participating in the procurement.

"Contract Documents" are the standard bid and contract forms. It should be noted that although the bid forms and associated General and Special Provisions will not apply directly to the technical proposal (Step 1), proposers should be made aware of the conditions under which they are to bid their proposals in Step 2.

"General Provisions" are standard contract provisions.

"Special Provisions" include modifications and addenda to General Provisions and are mostly standard for a given District or location. The District should review these provisions for appropriateness in a Two-Step procurement.

The "Technical Specifications" contain design requirements and technical specifications for the project. The specifications are to be performance-oriented; design and engineering requirements are specified, but the proposer has the option of selecting materials and developing and detailing a definitive

design. It is anticipated that the District will develop material specifications using Corps guide specifications and commercial industry standards. It is suggested that material specifications be as open as practical so as not to impose unnecessary restrictions on a proposal and to allow a proposer to work with the standards with which he/she is most familiar.

"Drawings" will provide a graphic representation of the Type IIIa architectural design requirements. The drawings included in this report should be suitable for inclusion in the RFTP.

It must be noted that each Corps District is likely to format both the contract provisions and the technical specifications according to its own standard practices and preferences. Thus, the completed RFTP package may not be identical to the outline given here.

9 PROJECT COST

A cost estimate was developed for fabrication and erection of Type IIIa ATCTs. This estimate was used primarily to indicate whether a Type IIIa ATCT facility could be constructed for less than the \$200,000 ceiling imposed by Operations and Maintenance, Army (OMA). Since construction locations, site conditions, contract arrangements, and time of construction are unknown, this estimate must not be interpreted as a definitive bid or even as a concept estimate. However, qualitative conclusions have been drawn from the estimate; should the engineering agency administering procurement and construction of this type of facility want this cost data, it can be provided by USA-CERL.

Cost Comparison

To assess the economic feasibility of the prefabricated modular approach, a cost estimate was also developed for a Type IIIa ATCT facility as though it were individually designed and constructed conventionally on-site. This design was identical to the design displayed in this report, differing only in structural and construction approach.

For the complete configuration (a 60-ft-high tower and three Base ATC Operations modules), the modular prefabricated approach resulted in about a 10 percent savings over individual design and conventional site construction. This lower cost is a result of the following factors:

1. Efficiency and material savings in the structural design
2. Reduced costs for shop labor
3. Reduced design and administrative costs resulting from an aggregated procurement
4. Reduced construction contractor overhead costs because of less on-site work.

Packaging and transportation will incur significant costs for the prefabricated modular configuration. Costs were included for crating the modules for CONUS transport and a 400-mile delivery distance. However, even these extra costs were not enough to offset savings in other areas.

Type IIIa ATCT Construction Cost

In its complete configuration (the 60-ft-high tower and three Base ATC Operations modules), fabrication and erection of the Type IIIa ATCT will very likely approach or exceed the \$200,000 ceiling. This figure includes a cost for foundations, but not for sitework. Therefore, it is unlikely that the complete configuration can be constructed for less than \$200,000.

There will be cases where the complete Type IIIa ATCT configuration will not be required. Specific site conditions may dictate a tower height of less than 60 ft, and existing facilities may preclude the need for all three Base

ATC Operations modules. In these cases, up to four modules can be omitted and costs deducted accordingly.

Since site conditions and required site work are unknown, it is impossible to indicate the reduction in scope from the complete configuration needed to construct a complete and usable facility for less than \$200,000. However, it is apparent that the complete configuration would have to be reduced by two or three modules (either intermediate stair modules or base ATC operations modules) to enable foundation construction and minimum site development for at a \$200,000 total project contract cost.

In any case, it is imperative that the engineering agency administering these facilities' fabrication and construction verify costs according to location, time of construction, required site work, and local construction community capabilities and practices. If the facility cannot be constructed for less than \$200,000, ACTA should pursue an alternative funding source.

10 CONCLUSIONS AND RECOMMENDATIONS

The Type IIIa ATCT design displayed in this report meets ACTA functional requirements for prefabrication, modularity, and transportability. The design can be developed into a building system suitable for volume fabrication in a variety of configurations or can be developed into individual designs for conventional site construction.

Several construction approaches may be taken when developing the Type IIIa ATCT building system. It is therefore advisable that ATCA pursue a "design/build" procurement strategy to capitalize on innovations and competition within the modular building industry. Two-Step Formal Advertising or One-Step Competitive Negotiation are appropriate methods.

Prefabricated construction and a design/build procurement approach will create some unique conditions that are not found in a typical military construction project, and these must be addressed. They include the capabilities of proposers, composition of bidding documents, transportation of modules, quality control, Government acceptance of prefabricated construction, and accommodation of the various deployment scenarios.

A prefabricated, modular, and aggregated procurement approach is economically advantageous over individually designed and site-built Type IIIa ATCT structures administered in the usual fashion. The cost savings is about 10 percent. Economies are found in the efficiency of the structural design, reduced costs for shop labor, reduced design and administration costs, and reduced construction contractor overhead costs.

Construction of a complete and usable Type IIIa ATCT facility will most likely cost more than \$200,000 in its complete configuration (60-ft tower height and three base ATC operations modules). However, costs can vary considerably due to specific project conditions and local construction economy. Where the scope of the facility can be reduced (by omitting some of the stair or Base ATC Operations modules), a complete and usable Type IIIa ATCT facility can most likely be constructed on a developed site for less than \$200,000. A definitive conclusion, however, must only be made on a project-specific basis when all specific conditions are known.

If ATCA is to pursue a Type IIIa ATCT construction program, they should identify project sites and definitive construction requirements and contact an engineering agency to administer the prefabrication and construction efforts. The engineering agency should be the Corps of Engineers District within which most of the Type IIIa ATCT facilities will be constructed. The District should complete the bidding documents, administer the fabrication contract for the building system, and either accept the building system packages and transfer responsibility to ATCA, or administer the construction contract and transfer the complete facility to ATCA.

The District should acquire the Type IIIa ATCT facilities, using a one-step or two-step procurement approach. The RFP or RFTP should be completed according to the guidance provided in this report. The prototype concept design should be included within the RFP or RFTP as a definitive architectural design. It can then be used as a master design and procurement document that can be edited to suit the specific conditions of subsequent procurements.

APPENDIX A:

OUTLINE REQUEST FOR TECHNICAL PROPOSAL

This appendix outlines the suggested contents of the Request for Technical Proposal (RFTP) document for a U.S. Army Type IIIa ATCT.

The RFTP should not differ radically from a conventional bid package. However, the two-step procurement process will require some adjustments to the contractual, specification, and graphic materials normally included in a bid package. Furthermore, the unique nature of the Type IIIa ATCT, and the fact that this is a fabrication contract, will require that special consideration be given to some items (see p 101).

The following outline is intended to provide the Engineering Agency completing the RFTP (the Corps District) with guidance on the content and organization of the RFTP. It is also intended to identify and describe important elements of the project's administration, design, and technical requirements.

METRIC CONVERSION FACTORS

1 ft = 0.3048 m
1 sq ft = .093 m ²
1 in. = 25.4 mm
1 psf = 4.8824 Kg/m ³
1 mph = 1.609 Km/hour
1 lb = .4535 Kg
1 cfm = .00047 m ³ /minute
°C = (°F - 32) (5/9)

I. REQUEST FOR TECHNICAL PROPOSAL (RFTP)

Introduction

Provide a brief introductory statement describing the facility type, requirement for prefabrication services, and the procurement's design/build orientation.

Description of Work

Describe the Type IIIa ATCT facility, its basic design and functional requirements, requirements for modularity and adaptability, potential deployment scenarios, requirement for prefabrication under this contract, and use of two-step procurement.

Procurement Procedures

Describe the two-step formal advertising process. Indicate proposer's responsibilities under Step 1, the evaluation process, Step 2 bidding, and the basis for contract award. Briefly explain the winning proposer's post-contract responsibilities.

RFTP Content and Overview

Describe the contents of the RFTP in terms of the contractual, design, and technical requirements for the Type IIIa ATCT. Describe the specification approach. Indicate the RFTP's authority as the binding construction document in the project.

Proposer Responsibilities and Options

Describe the proposer's latitudes and restrictions in developing his/her own definitive design in response to the RFTP. Indicate that the proposer is limited to the architectural design as shown, its overall dimensions, and the maximum and minimum dimensions shown. Indicate that the proposer is to complete the definitive design, structural configuration, and detailing, and has the option of selecting materials and components from among those specified. Indicate the required conformance to material specifications.

Alternative or Multiple Proposals

Encourage the submittal of multiple proposals. Indicate that each alternative must be an independent proposal and will be evaluated as such.

Pre-Proposal Conference

It is recommended that a pre-proposal conference be conducted during proposal development to clarify RFTP provisions, resolve questions, and identify potential problems. Designate the time and place of the conference.

Procurement Schedule

Indicate intended dates for proposal submittal, invitation for bid, contract award, and completion of fabrication.

II. INSTRUCTIONS TO BIDDERS (Standard Form 22)

There should be no unusual requirements for this section.

III. SPECIAL INSTRUCTIONS TO BIDDERS

There should be no major changes to standard special instructions. A suggested list of required submittals for proposal is included at the end of this appendix. Provisions may include:

Clarification of the Provisions of the Request for Technical Proposal
Site Visits and Inspection
Registration of Designers
Plant Available for Production
Bid Bond
Bonding Company Certificate and Notice
Instructions for Technical Proposal Preparation
 Availability of Specifications and Standards
 Definitions
 Drawings and Requests for Proposals Sets
 Cost Limitation
 Royalty Information
 Required Technical Data for Proposal
 Requirements for Special Marking of Technical Data
 Formats for Technical Data
 Unnecessarily Elaborate Proposals
 Acknowledgement of Receipt of Amendments
Instructions for Technical Proposal Submission
 Proposal Delivery Address
 Restrictions or Disclosure of Data
 Disposal of Proposal
 Bidding Materials
 Arithmetic Errors
Modifications Prior to Date Set for Receipt of Technical Proposal
Withdrawal of Technical Proposals
Time for Acceptance of Proposals by the Government
Nonconforming Proposals
Evaluation Procedures
Evaluation Criteria
Public Opening of Bids

Basis of Award
Deductive Items
Termination of Solicitation
Payment and Performance Bonds

IV. CONTRACT DOCUMENTS

There should be no unusual requirements for this section.

V. GENERAL PROVISIONS

There should be no unusual requirements for this section.

VI. SPECIAL PROVISIONS

There should be no major modifications to standard Special Provisions. These sections should be reviewed for appropriate language regarding Two-Step procurement.

Statement of Work
Commencement, Prosecution, and Completion of Work
Liquidated Damages
Drawings, Maps, and Specifications Accompanying Request for Proposal
Physical Data
Labor and Wages
 Davis Bacon Act - Site of the Work
 Stabilization of Prices, Rents, Wages, and Salaries
 Wage Rates
Government Rights
Limitation of Payment for Design
Design and Approval
 Authorized Representative of the Contracting Officer (CO) and Resident CO
 Inspection
Required Insurance
Masculine Gender Terminology
Formal Contract
Testing
Damage to Work
Buy American Act
Environmental Protection
Approved Equal
Equal Employment Opportunity
Listing of Employment Openings
Responsibility of the Contractor
Contractor Quality Control
Modifications
Purchase Orders
Certification of Compliance
Warranty of Construction
Time Extensions
Schedules and Schedule Reports

Final Design Analyses, Construction Drawings, and Specifications
Shop Drawings
Record Drawings
Erection Manual
Operation and Maintenance Manual
Submittal Scheduling and Control
Safety Requirements
OSHA Standards
Accident Prevention Plans

VII. OUTLINE OF TECHNICAL SPECIFICATIONS

The following specification outline displays the items to be included in the completed RFTP. The specification is intended to be performance-oriented, although not necessarily a "performance specification" in the strictest sense of the term. Given specified performance criteria for the building, a proposer will be given the latitude to complete a definitive design for a Type IIIa ATCT, develop details, and select many materials and components. Specifications for the materials themselves, or acceptable options or alternatives, can be provided descriptively as usual. This approach should give a proposer enough latitude in design to encourage efficiencies and innovation, while allowing the engineering agency which will complete the RFTP (the Corps District) to maintain necessary controls on material quality. Furthermore, this approach allows the District to use the types of specifications with which it is most familiar.

This outline is organized according to the Construction Specifications Institute's **MASTERFORMAT**.⁷ Performance criteria for the total building system and its major components are specified in Division 13 - Special Construction. Divisions 3 through 12 and 14 through 16 contain the generally descriptive, material-oriented specifications.

DIVISION 3 - CONCRETE

Foundation design and concrete specifications will be included in the erection contract.

03250 Concrete accessories, anchors, and inserts

Specify that the fabricator is to designate types and layout of anchorage appropriate to his design. Specify that the fabricator is to provide a template or frame with each foundation-mounted module to accurately locate anchors during foundation installation.

DIVISION 4 - MASONRY

No masonry specifications are anticipated.

⁷MASTERFORMAT, Construction Specifications Institute Document MP2-1 (Construction Specifications Institute, 1983).

DIVISION 5 - METALS

05120 Structural Steel

Specify structural steel shapes, fasteners, welding, painting and coating, and other structural steel items as usual. Specify that all module-to-module connections shall be bolted and capable of being disconnected.

05310 Steel Deck

Specify steel deck and steel roof deck materials, painting and coatings, and accessories as usual.

05410 Cold Formed Metal Stud System

Specify metal studs, channels, welding, fasteners, painting and coatings, and accessories as usual. Indicate that the fabricator is to determine the use of this specification as it applies to his design.

05420 Cold Formed Metal Joist Systems

Specify metal joists, ledgers, welding, fasteners, painting and coating, and accessories as usual. Indicate that the fabricator is to determine the use of this specification as it applies to his design.

05510 Metal Stairs

Specify as usual.

05520 Handrails and Railings

Specify as usual. Indicate that the railings projecting into the cab shall be removable.

05530 Gratings and Floor Plates

Specify as usual.

DIVISION 6 - WOOD AND PLASTICS

06115 Sheathing

Specify fire-retardant subfloor and fasteners as usual. Specify that the fabricator is to determine the use of this specification as it applies to his design.

06220 - Millwork

Specify cabinets, shelving, and trim as usual.

DIVISION 7 - MOISTURE AND THERMAL PROTECTION

07190 Vapor and Air Retarders

Specify vapor-retarding membrane materials as usual. Specify conditions where such items are required. Indicate that the fabricator is to determine the use of these specifications as they apply to his design.

07210 Building Insulation, and

07220 Roof and Deck Insulation

Specify all acceptable wall, roof, and floor insulation materials and accessories as usual. Indicate that the fabricator is to determine the use of these specifications as they apply to his design. Insulation integral with manufactured items will be addressed under those sections.

07410 Preformed Roof and Wall Panels (Wall Panels)

Performance-specify insulated metal wall panels and accessories. Criteria should address all materials and components of an integrated wall system. Allow "factory insulated" or "field insulated" wall systems. Include the following criteria.

A. Fire Safety

Specify appropriate flame spread and smoke development ratings.

B. Strength

Specify maximum allowable horizontal deflection under loads referenced in section 13120. Specify appropriate impact resistance.

C. Durability

The Type IIIa ATCT is to have a life expectancy of at least 25 years, and some of these structures may experience potentially severe environmental conditions. Specify weathering and corrosion resistance criteria for panel skin materials, painting and coating, and all accessory items commensurate with this life expectancy. Specify appropriate scratch resistance and puncture resistance criteria.

D. Transmission

Specify maximum U-factor of .05. Specify that joints, fasteners, and accessories shall be detailed to prevent thermal bridging or otherwise compromise the thermal resistance of the panel itself. Specify that vertical and horizontal joints, fasteners, and accessories shall be detailed to allow positive drawings of water over the detail and prevent penetration into the interior of the tower.

E. Aesthetics

Specify an embossed texture for the panels' exterior skin. Specify that all like items be of uniform color. Reference section 13120 for exterior wall color.

F. Measurable Characteristics

Specify appropriate tolerances for panel plumbness, flatness, and prevention of "oil-canning." Specify appropriate tolerances for joints between shop-installed panels. Specify appropriate tolerances for joints between field-installed panels and horizontal joints between modules.

G. Interface Characteristics

Specify attachment to superstructure by concealed fasteners. Specify that the interface of doors, windows, vents, and other penetrations shall maintain structural and weathertight properties of wall system. Specify that interior skin shall be of sufficient thickness or gage to surface-mount such items as electrical panel boxes and raceways, conduits, etc.

H. Service

Specify that the wall panel system shall not be progressive in installation sequence. Specify capability to remove and replace any panel at any location without disturbing adjacent panels.

07410 Preformed Roof and Wall Panels (Roof Panels)

Specify standing seam metal roofing as usual. Include provisions for attachments, gutters, scuppers, drains, downspouts, curbing, flashing, and other accessories as an integrated system. Specify appropriate provisions for mounting the lightning rod. Indicate potential additions to the Base ATC Operations Building and the appropriate roof interface conditions. Indicate that the fabricator is to determine the use of this specification as it applies to his design.

07530 Elastomeric Sheet Roofing

Specify mechanically fastened or loose-laid single-ply roofing system as usual. Include appropriate provisions for gutters, scuppers, drains, downspouts, curbing, flashing, and other accessories as an integrated system. Specify appropriate provisions for mounting the lightning rod and for foot traffic protection. Specify capability to achieve field repair by means of adhesive or portable thermal sealing device. Indicate potential additions to the Base ATC Operations Building and the appropriate roof interface conditions. Indicate that the fabricator is to determine the use of this specification as it applies to his design.

07600 Flashing and Sheet Metal

Specify flashing or sheet metal for roof applications not appropriate under 07410 or 07530. Specify prevention of water leakage at critical details (such as fascias, at cab "cap," between modules, at foundations, at penetrations,

at canopy, etc.). Specify flashing materials and accessories as usual. Indicate that the fabricator is to determine the use of these specifications as they apply to his design.

07720 Roof Accessories

Specify roof hatch as usual.

07910 Joint Filters and Gaskets, and

07920 Sealants and Caulking

Specify all acceptable materials as usual. Specify conditions for which fillers, gaskets, sealants, and caulking must be used. Indicate that the fabricator is to determine the use of these specifications as they apply to his design.

DIVISION 8 - DOORS AND WINDOWS

08110 Steel Doors and Frames, and

08500 Metal Windows

Specify steel and/or aluminum casement windows for the Base ATC Operations Building as usual. Specify thermal-break frames. Specify water leakage, air infiltration, and condensation criteria. Reference AAMA 302.9 and 1502.7 as appropriate.

08650 Special windows

Specify steel and/or aluminum windows for the tower cab as usual. These windows are to be operable, top-hinged, in-swing for cleaning. The swing is to be a minimum of 30 degrees from the fixed position. Specify thermal-break frames. Specify water leakage, air infiltration, and condensation. Reference AAMA 302.9 and 1502.7 as appropriate. Reference 13120 for building structural requirements.

08700 Hardware

Specify door and window hardware as usual.

DIVISION 9 - FINISHES

09510 Acoustical Ceilings

Specify suspended acoustical ceilings and acoustical tile ceilings as usual.

09650 Resilient Flooring

Specify sheet and/or tile flooring and accessories as usual. Specify appropriate surface preparation for plywood subfloor or concrete slab. Indicate fabricator has the option of providing either sheet or tile flooring (if appropriate).

09680 Carpet

Specify carpet and accessories as usual.

09910 Exterior Painting, and

09920 Interior Painting

Specify painting as usual for those items where painting or coating is not already specified.

09985 Prefinished Panels

Specify all acceptable materials that may be used for partition finishes, as usual. Interior partitions may be of prefabricated panel type or prefinished panels applied to metal stud framing. Specify that fasteners shall be concealed. Specify capability to remove and replace any panel at any location without disturbing adjacent panels. Specify that the skin shall be of sufficient thickness or gage to surface-mount such items as electrical panel boxes and raceways, conduits, etc.

DIVISION 10 - SPECIALTIES

10120 Tackboards,

10210 Metal Wall Louvers,

10500 Lockers, and

10800 Toilet and Bath Accessories

Specify as usual.

DIVISION 11 - EQUIPMENT

11452 Residential Appliance

Specify under-counter refrigerators as usual.

11458 Disappearing Stairs

Specify wood or aluminum hideaway stairs for the cab roof as usual.

11460 Unit Kitchens

Specify prefabricated kitchen units as usual. The unit is to include sink, refrigerator, and cabinets comparable to configurations shown in drawings.

Indicate that the fabricator is to determine use of this specification as it applies to his design. Reference section 15450 for accommodation of under-counter or on-demand water heater.

11850 Navigation Equipment

Reference schedule for descriptions and dimensions for Government-furnished, Government-installed air traffic control equipment.

DIVISION 12 - FURNISHINGS

12520 Window Shades

Specify as usual. Reference FAA-E-2470 as appropriate.

DIVISION 13 - SPECIAL CONSTRUCTION

13120 Pre-Engineered Structures

1.01 General Description

Provide a general description of the Type IIIa ATCT. Describe its modular, prefabricated, transportable characteristics. Describe possible variations in building configuration regarding tower height and ATC Base Operations Building modules. List modules and configurations required for the specific procurement. Describe characteristics of the building, its operations, or of the specific procurement that are not evident from the graphic material or specifications.

1.02 Total Building System

A. Fire Safety

Reference NFPA 101 for stair dimensions, escape ladder dimensions, doors, doorswings, and clear dimensions, with the following exception: tower stairs to have treads of minimum 9-1/2 in. and risers of maximum 8 in.

Specify weatherstripping or other appropriate means of smoke propagation control from the stairwell to the cab, stairwell to the kitchenette, and mechanical room to all adjacent spaces. Specify smoke detectors and smoke-actuated switch to tower stairwell vent fan.

B. Property Protection

Specify appropriate provisions for intrusion resistance at windows and the fire escape ladder. Reference section 16700 for the intercom/electric lock system.

C. Strength

Specify the following live loads:

Floors:	100 psf
Roof:	55 psf
Stairs, landings:	100 psf
Balcony:	100 psf
Ladders:	100 psf
Balcony/roof railings:	200 lb, horizontal or vertical
Uplift, buildings and canopy:	To be calculated by fabricator.

Specify a peak wind load of 95 mph, orientation being potentially from any direction.

Specify that the fabricator is to identify all dead loads in his/her engineering calculations and accommodate those loads in his design.

Specify seismic zone 4.

Specify appropriate load combinations.

Specify that the Type IIIa ATCT design is to accommodate all thermal movements incurred in an ambient temperature range of -45°F to 106°F.

D. Transmission

Specify a maximum U-factor of .05 for roofs, walls enclosing conditioned spaces, and floors over nonconditioned spaces.

Specify the insulation of all interior surfaces from direct exposure to the exterior--prevent "thermal bridging."

Specify appropriate measures to prevent air, vapor, or water penetration at critical details.

Specify acceptable roof slopes and configurations for the removal of run-off.

E. Aesthetics

Specify that the overall appearance of the Type IIIa ATCT shall reflect a well-designed permanent facility. Materials, details, and other exterior features shall be consistent with the overall architectural quality. Avoid the appearance of a strictly utilitarian structure.

Specify provisions for Contracting Officer's approval of building colors. Indicate acceptable colors as follows:

Overall buildings:	Neutral light color (off-white, light beige, etc.)
Doors, windows, trim:	Complementary darker color (bronze, brown, tan, etc., not black)
Fascia, rails, ladder:	Same as trim
Cab exterior:	Same as building

Specify uniformity in color among like items

F. Measurable Characteristics

Specify appropriate fabrication tolerances.

Specify appropriate plumbness tolerance for the erected tower structure.

G. Interface Characteristics

Specify the appropriate tolerances for the proper fit of the following items:

- Module-to-foundation
- Module-to-module, horizontal and vertical
- Doors, windows, and openings
- Stairs
- Ladder, balcony, rails
- Partitioning
- Attachment of mechanical distribution
- Attachment of plumbing distribution
- Attachment of electrical and communication distribution
- Accommodation of ATC equipment

H. Erectability

Specify provisions for moving, lifting, and placing prefabricated modules. Specify appropriate provisions for efficient module assembly and field connections, and for hook-up of mechanical, plumbing, and electrical systems. Specify the appropriate provisions for the accommodation of ATC equipment.

I. Delivery and Protection

Specify the appropriate provisions for the protection of modules' dimensional integrity, exterior surfaces, interior surfaces, integral equipment, and fixtures. Specify the appropriate provisions for packing/packaging of stairs, ladders, railings, and other separate items. Specify appropriate provisions for preservation and storage of modules and accompanying packages.

2.01 Superstructure

Describe the superstructure as a structural steel frame configured in modules. Floor and roof construction shall be of light-gage joist with metal deck. Floors shall have a fire-retardant plywood subfloor. Connections between modules shall be bolted or otherwise detachable.

Specify that the proposer will be responsible for completion of the definitive structural configuration, engineering design, and detailing. The proposer will have the option of selecting components and materials appropriate to his structural design. Reference the appropriate material specifications.

2.02 Exterior Walls

Describe the exterior wall construction as an insulated metal sandwich panel wall system. All panels, attachments, trim pieces, and other accessories shall be designed as an integrated wall system.

Specify that the proposer will have the option of selecting the wall panel system, panel construction, insulation materials, skin materials, finishes, and details. Reference appropriate material specifications.

2.03 Roof/Roofing

Describe roof construction as being either a single-ply elastomeric roof or a standing seam metal roof. Roofing materials, flashing, seam construction, attachments, drains, curbs, and other accessories shall be designed as an integrated roof system. Specify that the tower roof drain to one corner, with the storm leader being concealed in a corner column of the cab top.

Specify that the proposer has the option of selecting the roof system, insulation, materials, accessory items, and details. The proposer will also have options regarding roof configuration, slope, and drainage of the ATC Base Operations modules. Interior or exterior downspouts should be allowed. Reference appropriate material specifications.

2.04 Partitions

Describe interior partition construction as being either prefabricated panel type or prefinished panels applied to metal stud framing.

Specify that the proposer has the option of selecting the construction type for the partitions, insulation materials (where necessary), and detailing. Reference appropriate material specifications.

DIVISION 14 - CONVEYING SYSTEMS

14610 Fixed Hoists

Specify manual hoist at the tower balcony as usual.

DIVISION 15 - MECHANICAL

15010 Basic Mechanical Requirements

Specify plumbing design criteria or reference appropriate codes or standards as usual.

Specify HVAC design criteria. Include the following parameters:

Interior heating: 72° (tower), 68° (Base ATC Operations Building)

Interior cooling: 74°F at 50 percent relative humidity (tower), 76°F at 50 percent rh (Base ATC Operations Building)

Winter design temperature: -40°F*

Summer design temperature: 106°F*

Ventilation: 15 cfm/person in conditioned spaces

Occupancy: 4 (tower, cab)

7 (Base ATC Operations Module)

Equipment load: 3 W/sq ft of conditioned space

Specify that the proposer is to complete the mechanical design, select equipment, and develop configurations and details.

15250 Mechanical Insulation

Specify as usual. Specify insulation of any duct or pipe in an unconditioned space.

15400 Plumbing

Specify all acceptable piping materials, attachments, and accessories as usual. Indicate proposer's option to select among acceptable materials.

Specify plumbing fixtures and equipment as usual. Specify under-counter or recreational vehicle-type or "on-demand" water heaters for each lavatory and sink in the tower and Base ATC Operations Building.

15500 HVAC

Specify materials and equipment as usual. Specify a forced-air electric furnace with direct expansion (DX) air-conditioning unit, and shock-mounted with flexible vibration damping at all duct, electric, and plumbing connections. Specify a condensation drain to run into the tower sanitary drain if condenser evaporation is not used. Specify an electric forced-air heater with thermostat control for the tower stairwell. Specify that mechanical equipment be physically sized to be removable through doors and from tower base buildings.

Specify a louvered closable grill at the bottom of the stair enclosure of about 16 in. by 16 in. Specify a louvered closable grill at the top of stair enclosure with an exhaust fan of 1000 cfm capacity. Specify that the fan be actuated by a thermostat control switch at the location of the fan and a smoke detector at the uppermost surface of the stair enclosure. Specify a louvered closable grill with a 100 cfm fan in the break/briefing module of the Base ATC Operations Building. Specify all grills to be weathertight and resistant to animal/bird intrusion.

*99 percent load level per TM 5-785, Engineering Weather Data.

15880 Air Distribution

Specify all acceptable ductwork materials, veins, dampers, diffusers, and accessories as usual. Specify that fiberglass ducts exposed to occupied spaces be protected from damage. Specify that ducts be sized to provide adequate air distribution at a low noise level. Specify a maximum velocity of 1000 ft/min for delivery and a maximum velocity of 750 ft/min at return face. Specify returns with balancing dampers in the cab and support module (minimum one each). Specify diffusers in the cab module to blow upwards and over the entire glazed area and to be directionally adjustable. Provide balancing dampers at a minimum of 30 in. upstream from the face of each supply diffuser in the cab module. Specify that balancing dampers shall remain accessible after completion of construction.

15950 Controls

Specify that the tower thermostats be located in the cab module, located so as not to be directly exposed to solar radiation or supply air flow. Specify that the thermostat in the Base ATC Operations Building is to be located in the equipment/repair module, so as not to be directly exposed to solar radiation or supply air flow. Thermostats are to be a programmable heat-and-cool type with setback capabilities. The fan shall have automatic and manual "fan only" modes.

DIVISION 16 - ELECTRICAL

16010 Basic Electrical Requirements

Specify electrical design criteria or reference appropriate codes or standards as usual.

Specify that the proposer is to complete the electrical design, select equipment, and develop configurations and details.

16400 Service and Distribution

Specify all acceptable materials, equipment, and accessories as usual. Electrical distribution is to be surface-mounted on walls and exposed ceilings, and concealed above suspended ceilings. Either conduit or surface-mount raceways should be allowed.

16500 Lighting

Specify all acceptable types of lighting fixtures as usual. Illumination requirements are as follows:

Cab (down-lights): 50 footcandles at console (fixtures will be rheostat-switched)
Cab (general illumination): 30 footcandles
Kitchenette: 30 footcandles
Lavatories: 10 footcandles
Equipment/repair module: 30 footcandles
Base ATC Operations Office: 30 footcandles

Break/briefing module: 20 footcandles
Stairs, landings, hallways: 5 footcandles

16660 Ground Fault Protection

Specify as usual. All kitchen and toilet outlets and lights are to be ground fault circuit interrupters. The tower's vertical ground riser should be installed by the erector as one continuous run (1/0 AWG copper, yellow insulation, brazed at each level, and bolted at ground level (Reference STD-AF-0191)).

16670 Lightning Protection

Specify as usual.

16700 Communications

Specify intercom system with remote-controlled electric locks as usual. The intercom is to connect the tower cab with the tower entrance and the Base ATC Operations Building entrance. Electric locks for each entrance are to be remote-controlled from the tower cab.

VIII. DRAWINGS

Include the appropriate graphic material as indicated on pp 31-81. Drawings should include the following:

Architectural	A1 - A-24
Mechanical	M1 - M-6
Plumbing	P1
Electrical	E1 - E-6
Structural	S1 - S-4
Air Traffic Control	ATC1 - ATC-9

Suggested Proposal Submittal Requirements

Proposals shall include both written (narrative) and graphic description of the design proposal sufficient to express the proposal concept design to the 20 to 25 percent completion level. Documentation shall be sufficient to indicate the overall design concept, the structural system, electrical system, plumbing system, HVAC system, equipment support systems, and closure systems in sufficient detail to determine technical adequacy. Submission should include the following:

1. Narrative Description: A written description discussing the overall concept or approach to system design including the rationale behind configuration, design, and selection of all systems and materials. The description shall include concept design analyses sufficient to support selection and

preliminary sizing of all systems; however, final capacities and sizing are not required.

2. Concept Drawings:

a. Architectural floor plans indicating identified activities and ATC equipment/furniture placement, HVAC equipment placement, plumbing equipment placement, sizes of areas and basic/critical dimensions, door swings, and cabinetry placement for the following areas:

- (1) Roof for tower and Base ATC Operations Building
- (2) Cab module
- (3) Support module
- (4) Stair module(s)
- (5) Ground module
- (6) Base ATC Operations Building

b. Mechanical floor plans indicating general layout and equipment/fixture/mechanical distribution placement for the architectural floor plans as applicable above covering the following mechanical systems:

- (1) HVAC
- (2) Plumbing
- (3) Electrical
- (4) Equipment cable raceways

c. Elevations, all views, indicating fenestration, configuration, basic materials, and basic/critical dimensions.

d. Sections for clearly depicting critical/complex areas/relationships difficult to describe in plan, such as tower cab and stair tower, as a minimum.

e. Details for critical sections including as a minimum, the following:

- (1) Roof/wall interface/connection
- (2) Module/module interface/connection structural and mechanical
- (3) Module/foundation interface/connection
- (4) Wall/floor interface/connection
- (5) Wall/wall interface/connection

(6) Tower/Base ATC Operations Building canopy interface/connection.

f. Special drawings (isometrics, sections, details) as required to describe special characteristics of proposal.

3. Specifications: Outline specifications conforming to the Construction Specifications Institute (CSI) 16-Division format indicating the quality of materials, construction, finishes, fixtures, and equipment to be provided.

4. Product/Manufacturer Technical Literature: Technical literature as necessary to describe systems characteristics, performance, details, materials, and finishes. If technical literature is sufficient to describe details requiring separate detail sections (2e above), these may be eliminated. The following is required as a minimum:

- a. Roof system
- b. Wall panel system
- c. Windows
- d. HVAC equipment
- e. Package kitchenette/cabinetry
- f. Under-counter refrigerator
- g. Water heaters/cooler
- h. Lighting/electrical equipment/intercom
- i. Cable/wiring raceways
- j. Hoist
- k. Finishes - ceiling/floor
- l. Window shades

APPENDIX B:

GUIDANCE FOR TECHNICAL PROPOSAL EVALUATION PROCEDURES

Evaluation Context and Objectives

The evaluation process is critical to the successful execution of a two-step procurement. It must assure the complete satisfaction of all user requirements by determining proposal compliance with RFTP criteria, while remaining completely fair and objective to all proposers. To do this, it must be effectively structured to be executed in a timely manner, to confirm and document compliance with specified criteria, to assure fairness and objectivity to all proposers, and to be defensible in the context of appropriate procurement regulations.

A systematic evaluation will expedite the process by organizing all activities in advance and providing instructions for their successful completion. It assures that all use requirements are met by means of a checklist review of each criterion. It provides objectivity through continuity, in that each proposal is subjected to the same systematic evaluation. It justifies the propriety of contract award through the same continuity, verifying and documenting that the successful proposer meets all RFTP requirements.

The verification of proposal compliance before contract award is in the best interest of the user, the Government, and the proposer. If compliance is not established prior to award, there may be conflicts and changes during the course of the contract, thus compromising quality and timeliness.

The preparation of definitive evaluation documents, although not required by regulation, is strongly recommended. It is also recommended that evaluation documents be prepared concurrently with the RFTP. Concurrent preparation will help ensure that all contractual, design, and technical criteria are addressed, that each criterion can be evaluated, and that conformance is verifiable.

Evaluation Procedures

The evaluation process will not differ radically from a conventional design review. Proposal materials will be reviewed for compliance with RFTP criteria by the same professionals responsible for conventional design review. However, there will be more than one design to evaluate for the project. The evaluation will also be on a "conform/does not conform" basis, thus dispensing of the need for design review commentary.

Evaluation in a two-step procurement typically addresses four areas: General Conformance, Proposer Responsibility, Technical Conformance, and Cost. A General Conformance review establishes that all required submissions have been made and are in order. A preliminary Proposer Responsibility check precludes selection of a nonresponsible proposer. Technical Conformance criteria confirm the technical performances of proposals, allowing conforming proposers to proceed to the second-step bid. Cost is evaluated in the step-two bid on low cost alone.

Evaluation Personnel

Participating personnel should include representatives from the Air Traffic Control Activity (ATCA), as well as District engineering and contracting personnel. If the RFTP was developed in-house, the same personnel should be considered for evaluation. If the RFTP is prepared by an architect-engineer, they should also be asked to participate. District participants should be qualified personnel representing disciplines in which the proposal is involved. The District contracting personnel on the evaluation team should have the authority to disqualify a proposal which fails to meet the specified contractual requirements. Evaluation team selection should begin during RFTP development.

Proposal Receipt

Proposals will be received without bid prices and therefore do not have to be sealed; however, the content of the proposals must remain confidential, at least until after award. To ensure confidentiality and objectivity and to avoid the appearance of evaluation favoritism, it is also recommended that proposers' identities not be known to the evaluators. Proposers may submit all materials by a District-assigned RFTP number.

Proposals should be received by designated District personnel, and checked to confirm the receipt of all required elements and of individual elements documented. If a portion of a proposal appears to have been omitted, the proposer should be notified. Since submitted proposals will consist of bound printed materials, bid documents, and drawings, care should be taken to keep proposal materials together.

Pre-Evaluation Meeting

A pre-evaluation meeting should be held to brief the evaluators on the project, evaluation methods and objectives, and evaluation documents, and to encourage objective, comprehensive, and expedient evaluation.

Evaluation Procedures

Two approaches may be used for proposal evaluation: evaluation by the team or distribution by tasks.

The team approach allows all aspects of the proposal to be discussed. Members who are experts in one technical area may also be better able to judge the impact of their particular area on other building systems. However, some evaluation areas could take longer than others, thus incapacitating the entire team.

The task distribution approach assigns specific technical areas to individual team members. Members may work independently and spend only the time needed to evaluate their assignment areas. Communication should still be maintained among team members to insure that no item's design impacts adversely on other elements. A final review meeting should be held so that all evaluators can review the entire evaluation.

Evaluation procedures will address the following areas.

General Conformance. The evaluation for general conformance consists of simple verification that the proposer has fulfilled all the conditions required for participation in the procurement. This would include items such as providing the required professional certifications, acknowledging receipt of proposals, and submitting the required technical documentation.

Technical Conformance. The technical evaluation determines whether a proposal conforms to all RFTP design and technical requirements. This will entail examining proposal documentation to verify conformance with each such provision of the RFTP. However, it is unlikely that all items in the specification will be able to be evaluated at the proposal stage of a two-step procurement. Some items can only be verified upon completion of engineering analysis, submittal of shop drawings or samples, or installation. This distinction should be considered during RFTP development, and specifications drafted to clarify items to be evaluated at the proposal stage and those that will be verified after the contract award.

For each provision of the RFTP to be evaluated at the proposal stage, the following information must be considered:

1. The criterion specified in the RFTP.
2. The proposal's response to the specified criterion.
3. Whether the proposal has or has not satisfied the specified criterion.

Judgment of Proposal Conformance. After the proposal's evaluation is complete and a decision made regarding its conformance to each specification criterion, the proposal should be rated as "conforming," "conditional," or "nonconforming." A "conforming" rating means that the proposal conforms to each criterion in the RFTP and is eligible for bidding in step two. A "conditional" rating means additional information is required, or that the proposal requires only minor modifications to make it "conforming." Proposals requiring extensive modifications to conform to the RFTP criteria should be rated "nonconforming" and will not be eligible to bid in step two.

The District may also allow conditional proposals to be brought into compliance and to participate in bidding, especially when decreased competition will be disadvantageous. The distinction between "conditional" and "non-conforming" must be clear and equitable to avoid any inference of favoritism. In this case, the evaluation team must prepare a statement for each such "conditional" proposer, describing the proposal's deficiencies. However, these descriptions must not prescribe any corrective measures; that is the responsibility of the proposer. The District may require whatever submittals are necessary to verify compliance with the RFTP. Submittals may be a simple written statement indicating use of a different material, or may be a redesign of a building component accompanied with new specifications. For expediency, it is recommended that resubmittals be minimized to ensure conformance during contract execution. These submittals will become part of the proposal and will be binding.

Bidding and Award

The second step of a two-step procurement is the bidding of proposals. The District will issue an invitation for bid (IFB) to proposers whose proposals have been judged conforming and, if appropriate, to proposers whose conditional proposals have been brought into conformance. The bidding process should be conducted in the same manner as a conventional project. The lowest cost proposal must be recommended for contract award.

Evaluation Documentation

Evaluation documents should be prepared at the outset of the project, concurrent with RFTP development. These documents are intended to guide evaluators through the evaluation process, to provide a structure and organization to the evaluation process, and to document the evaluation proceedings. Evaluation documents will typically include: (1) introductory information on the project, procurement strategy, and evaluation process; (2) specific instruction on the execution of each evaluation step and task; and (3) necessary evaluation forms and worksheets.

Introduction

The introduction should include information general to the overall two-step evaluation process. It should briefly describe the project and discuss the importance of evaluation to the project's success. The general steps of the evaluation process should be described, as should the relationship of the RFTP provisions and the evaluation documents. The confidential nature of the evaluation proceedings should also be discussed.

Instructions

Instructions should be provided to the evaluators for each major step and individual task in the evaluation process. Definitive instructions may be incorporated directly with evaluation worksheets, reflecting the evaluation procedures discussed above.

Evaluation Worksheets

Evaluation worksheets provide organization and structure to the evaluation as well as documenting the results. For the Type IIIa ATCT project, they will be primarily "checklists" to ensure that each element of each proposal is checked for conformance against each appropriate RFTP criterion, and that the results are documented.

The District may develop worksheets for each of the following types of information: general conformance, technical conformance, description of non-conformance, and evaluation summary. All worksheets should include the project name and/or number, proposal identification or number (if appropriate), location and date, and name of the evaluator(s).

General Conformance. Items required of the proposer to exhibit general conformance to the conditions required for participation in the procurement

can be listed in a simple checklist fashion, with an indication of "provided" or "not provided."

Technical Conformance. Technical evaluation documents can be checklists reflecting each design and technical criterion and indication of conformance to each. Since the architectural design of the Type IIIa ATCT is displayed graphically and leaves little latitude for the proposer, checklist items need only include critical characteristics of configuration or dimensions. Checklist items for the technical specifications should include each specification item. The level of indenture to which specification paragraphs are represented in the checklist will depend on the composition of the specification. Broader headings can be used to the extent that a particular feature is not reviewed in an over-general fashion.

As an absolute minimum, the checklist should display the following headings: specification reference, short title, indication of "conforms" or "does not conform," and comments. Additional information can be included on the worksheets that will reduce constant referral to the RFTP document and help expedite the evaluation. The following information may be included, either implicitly or explicitly:

1. The criterion specified in the RFTP
2. The required submittals for the proposal
3. Whether the proposal includes the required submittals
4. The item, characteristic, or value exhibited in the proposal
5. The validity or accuracy of the proposer's verification
6. The proposal's conformance or nonconformance to the specified criterion.

Figure B1 shows example evaluation sheets.

Nonconformity, Documentation. The District may find it useful to further document a proposal's nonconforming elements. A simple one-page format that identifies the element and the appropriate criterion, and discusses the problem and the impact on the overall project should be sufficient. The discussion should include the basic criterion, how the proposal is in nonconformance with the criterion, and any recommended action.

Summary Documentation. The District may find it useful to summarize evaluation results for proposals having a number of nonconforming elements. It should summarize the discussion on nonconforming elements, indicate the impact of this nonconformance on the project, and provide recommendations. This will support a decision on whether to allow a proposer to bring a nonconforming proposal into compliance.

7.3 Roof covering shall be either steel or aluminum meeting the requirements specified below and shall have configurations for overlapping adjacent sheets or interlocking ribs for securing adjacent sheets. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place; width of sheets with interlocking ribs shall provide not less than 12 inches of coverage in place. Depth of configurations for roof covering shall be not less than 1 inch. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 25 feet or less. Sheets in excess of 30 feet shall have design provisions for thermal expansion and contraction. All sheets shall be square cut.

7.3.1 Steel covering: Zinc-coated steel conforming to ASTM A 446, G 90 coating designation, factory color finished; or aluminum-coated steel conforming to Mil. Spec. MIL-S-4174, type II, factory color finished; 26 Galvanized Sheet Gage or thicker.

7.3.2 Aluminum covering: Alloy conforming to ASTM B 209, temper as required for the forming operation, minimum 0.032 inch thick, factory color finished.

Example Specification

SPECIFICATION REFERENCE	PROPOSAL	SUBMITTAL	CONFORMANCE	COMMENTS
			yes	no
7.3 Roof Covering	<u>STANDING SEAM</u>	<u>DETAIL DRAWINGS</u>		
	<u>METAL ROOF</u>		✓	—
7.3.1 Steel Covering	<u>24 GA. ALUM.-</u>	<u>MFG. SPEC. (P.14)</u>		
	<u>COATED STEEL</u>		✓	—
7.3.2 Alum. Covering	<u>N.A.</u>			
			—	—
etc.				
etc.				
etc.				

Figure B1. Example evaluation worksheet.

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 ATTN: Facilities Engineer (3)

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TARCOM, Fac. Div. 48090

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 ATTN: DEH (19)

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